THE STUDY

ON

ENVIRONMENTAL & SAFETY PROTECTION EQUIPMENT

submitted to

COMMERCIAL DIVISION,CANADIAN EMBASSY

by Asoc.Prof.Sawart Yamvongsri
Faculty of Commerce & Accountancy
Thammasat University,Thailand

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FOREWORD

The project team has been commisioned by the Commercial Division, Canadian Embassy to conduct a Study on Environmental and Safety Protection Equipment Industry. The study covers the overview on Environmental and Safety Protection Equipment to the Canadian Investors who are interesting to invest in this industry.

The success of this study is a result of the cooperation and generosity of many people in both government and private sectors. Especially the officers from the Ministry of Industry, the office of the Prime Minister, Ministry of Science, Technologies and Energy etc, who gave worthy assistance and advices.

The Commercial Division, Canadian Embassy is appreciated for her honourary permission provided to us to undertake this study. It is hoped that this report will be able to help promote the Canadian investment in Environmental and Safety Protection Equipment in this country.

Assc.Prof.Sawart Yamvongsri
Researcher

February, 1990

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CONCLUSION AND RECOMMENDATION

Conclusion

Thailand is now facing an entangled problem in the environment which gradually disperses to affect other boundaries,the chaos of traffic jam renders bad air quality in every busy road, pedestrians suffer from the allergical smoke from buses and noisy automobiles. Those who live near a canal sniff the bad smell of odouring and polluting sewerage from their neighbour households. Away from the civilization and luxury life, the critical problem of the deforestation is attacking the fertile agricultural surroundings . The balance of marine life ecology is going to lost forever when the mangrove along the eastern and southern coasts are encroached to benify the shrimp farming.

The Thai government has been aware of the situation though it may be said that it is too late to react, great efforts has been spent to hold the left of the admirable environment to last as long as possible. Supportive measures are issued for privates to cooperate with government to conserve the conceal nature and reproduce the congestive lost while they can also gain in commercial terms.

As a new growing industrialised country, with an unexpected high growth rate, the problem of safety is visualised to the employer that it's the time to yield from his investment on safety concerns rather than solving employee's safety problems with higher expenses. Accidents from job execution, on travelling ,by electricity, fire, etc. have undermined an enormous unseen loss.

The facts that materialised such misery to the Thai people are :

1. The obsolete and unupdating regulations
2. The wan implementation of regulations and measures by the authorised officials have allowed a vacuum for the illegal practices.
3. The unrestricted and incontinuity long term efforts of several governments during the few decades hindered applicable assessment of implementation.
4. Most of the issues by several short term governments for the new approach to problems did not specified " a must" to the practitioners involved.
5. Lack of close cooperative efforts between government organizations by passing the responsive action to another bodies.
6. The habit of Thai people to " let it be" is a spoiling effect to society multiplied by the ignorance to public concerns, waves of complexity is the result

The ironic role of the few latest governments on environment has been set up concurrently with the same goals emphasizing on :

1. Updating and revision of the law and regulation obstructing the practical operation on environment aspects, eg. 30 year old Fire Act which did not reign the high rise building has been rewritten.
2. Urgent issues on environment conservation especially pollution control on various aspects are published and fully supported by large budgets.
3. Intensive measures are applied to completely stop the undisciplinary activities eg. breaching all private forest concession to cease deforestation, all hotels in Pattaya have to equip themselves with waste water treatment facilities, no more factory allowed to set up by the river side to prevent all wastes dumping.

Recommendation

It is expected in the next few years that the market related to the environment and safety equipments is going to gain a high prospect,

1. Several projects on pollution in Bangkok only costs over Baht 2,500 million should be attractive to follow up by Canadian investors.

2. The government reforestation plan of more than 100 million Rai is more or less a big magnate.

3. In major big cities, more than 100 high rise buildings of over 10 stories will be established in 2 years. Safety facilities like fire alarm, fire etardant partition, fire sprinkle, etc. can yield an interesting investment.

4. Further study on various specific industries related to the Environmental and Safety Protection Equipment should be concentrated.

RESEARCH METHODOLOGY

THE STUDY ON

ENVIRONMENTAL AND SAFETY PROTECTION EQUIPMENT

1.Objective

The study aims to identify opportunities that exist or will exist in Thailand for Canadian Investors on Environmental and Safety Protection Equipment.

2.Scope of Study

The Study on Environmental and Safety Protection Equipment comprises the following elements :

1. General Environmental Situation

2. Opportunities in Environment Aspects

3. General Safety Surroundings

4. Personal Safety Equipment Market and Opportunities

5. Organization and Related Agencies

6. Government Regulations

7. Government Projects

8. Distributors and Consultant Firms

3.Methodology

The primary data is obtained from structured interviews with the manufacturers , distributors and importers , and the secondary data collection from a number of government and private agencies.

Enterprises and Associations

A. Public Enterprises :

1. The Board of Investment (BoI)
2. Office of the Prime Minister
3. Ministry of Public Health
4. Ministry of Industry
5. Ministry of Interior
6. Bangkok Metropolitan Authority
7. Ministry of Science and Technology

B. Private Enterprises :

1. Manufacturers
2. Importers
3. Distributors

C. Association

1. Thai Industry Association
2. Thai Engineering Consultant Association

Moreover , apart from the above - mentioned sources , the secondary data is obtained from the following government agencies :

1. Customs Department
2. Ministry of Industry
4. Ministry of Interior
3. Ministry of Commerce
5. Ministry of Defense
6. Office of the Prime Minister
7. Thailand Development and Research Institute
8. Universities
9. Others

4.Timing

After planning the research design at the end of October 1989, then we obtained some secondary data from various sources of information. And at the end of November, we started to interview with both public and private sectors such as manufacturers, consultants, distributors, and importers of the Environmental and Safety Protection Equipment industry

After that we compiled the data and prepared for the report. Finally, we finished the report at the end of February 1990.

5. Problems and Limitation

1. Due to time constraint and incooperation of some manufacturers, distributors and importers, we cannot find out the more important figures on specific items in this industry.

2. The import and export data for the Environmental and Safety Protection industry is unable to be dug out because the presentation is sum up into one category eg. the value of import and export of Toe-shoes , it is categorised in "Shoes", inwhich is consisted of many types of shoes and no specific value shown.

3. Regarding the Personal Safety Equipment an unfamiliar product to most people the data on specific items have been available in a small group of manufacturers and importers, who are sensitive to competitors and new comers, the cooperation was nearly in vain.

GENERAL ENVIRONMENTAL SITUATION

1. **Forest Area** Thailand has total area of 320 million rai. Northern and northeastern regions are jointly biggest region with total area of about 106 million rai each, followed by southern (44 million rai), central (42 million rai) and eastern region (23 million rai) respectively.

In 1961, 53.3 per cent of the country's area is forest with northern region having highest ratio of forest area (68.5% of total area), followed by eastern region (58%), central region (53%), northeastern (42%) and southern (42%) respectively, However, ratio of forest are dropped remarkably to 28.0 per cent in 1988 with northern region still having highest ration (47%) followed by central (25%), eastern (22%), southern (21%) and northeastern (14%) respectively.

It is seen that during 1961-1988, forests in northeastern and eastern regions had been severely destroyed as proportion of forest area had been reduced from 42 and 58 per cent to only 14 and 22 per cent respectively. During the same period, half of forests in central and southern regions had been destroyed with proportion of forest area being reduced from 53 and 42 per cent to 25 and 21 per cent respectively. Northern region is the region with lowest rate of deforestation as proportion of forest area had been reduced from 69 per cent in 1961 to 47 per cent in 1988.

Table 1
Forest Area of Thailand

Unit : 1,000 Rai

Region	Total	Forest Area						
	Area	1961	1973	1976	1978	1982	1985	1988
North	106,028	72,672	70,997	63,954	59,336	54,848	52,579	50,251
East	22,814	13,227	9,398	7,894	6,898	5,000	4,994	4,896
Northeast	105,534	44,315	31,669	25,934	19,513	16,179	15,140	14,808
Central	42,124	22,288	14,981	13,641	12,766	11,573	10,768	10,700
South	44,197	18,516	11,522	12,587	11,002	10,276	9,678	9,143
Total	320,697	171,018	138,567	124,010	109,515	97,876	93,158	89,798

Source : Forest Department

Table 2
Percentage of Forest Area of Thailand

Unit : 1,000 Rai

Region	Total:	Forest Area						
	Area	1961	1973	1976	1978	1982	1985	1988
North	100	68.5	37.0	60.3	56.0	51.7	49.6	47.4
East	100	58.0	41.2	34.6	30.2	21.9	21.9	21.5
Northeast	100	42.0	30.0	24.6	18.5	15.3	14.4	14.0
Central	100	52.9	35.6	32.4	30.3	27.5	25.6	25.1
South	100	41.9	26.1	28.5	24.5	23.3	21.9	20.7
Total	100	53.3	43.2	38.7	34.2	30.5	29.1	28.0

Source : Forest Department

The main causes for the rapid reduction in forest areas are illegal cutting of trees, forest encroachment for agricultural purposes, shifting cultivation, rotation farming, government utilization of forest areas for other purposes such as dam construction and jungle fire, etc. In northern region, there is also problem of deforestation by hilltribes for shifting cultivation, and jungle fire is caused mainly by human rather than by nature.

2. Air Quality Thailand is formally an agricultural country which is progressing rapidly in science and technology sectors. In the past decades, the rapid economic growth has increased air pollution from industry, communication, transport, and other activities.

The major sources of air pollution are motor vehicles and the industries. There are more than 3 million motor vehicles in Thailand. The pollutants from motor vehicles include carbon monoxide, hydrocarbons, and suspended particulate matters (SPM). Lead from gasoline is also dangerous to public health.

Industry in Thailand is growing rapidly and there are more than 90,000 factories in Thailand at the present. Many of them cause air pollution, especially small plants which are located in the densely populated communities. Fishmeal and bone plants, metal smelters and plastic manufacturers usually causes problems with nearby residents.

This report points out the situation of air pollution obtained from the data collected by the office of National Environment Board (NEB)

2.1 Suspended Particulated Matter (SPM) Particulate matters exist naturally and also from manmade activities, such as from motor vehicles exhausts, traffics, industries. They can cause respiratory problems as well as visibility disturbance.

Results from Office of National Environment Board monitoring network of 1983-1986 shows that particulate matter levels of all stations are above, or very near the ambient air quality standards for SPM (0.10 mg/cu.m for annual average). The results indicate seriousness of the SPM problem in Bangkok Metropolitan area.

Hourly samples of SPM are also monitored and it is found that SPM level is always highest in the early morning when there is heavy traffic and calm wind condition.

Complaints from SPM problem also arise from activities such as tapioca loading and manufacturing, steel smelting and constructions, especially in the central and eastern provinces.

2.2 Lead Lead in the air usually comes from lead in the gasoline used as the antiknock agent. During combustion, lead is emitted with the exhaust gases into the air. Lead is a highly toxic substance which can cause gastrointestinal disturbances as well as effects on the nervous systems.

Lead levels in the air during 1983-1986 were found to be between 0.1-1.0 microgram/cu.m. and the annual means are from 0.19 to 0.66 microgram/cu.m., still far below the ambient air quality standard of 10 microgram/cu.m. the levels of lead decreased in 1984-85 since the government's reduction of lead in gasoline from 0.84 g/litre to 0.45 g/litre in 1984. Increasing use of diesel fuel and LPG which have no lead content also contribute to the downward trend of lead level in the air.

2.3 Nitrogen Dioxide Nitrogen dioxide is the result of high temperature combustion which causes reaction between oxygen and nitrogen to form nitrogen oxides (NO and nitrogen dioxide, which is brownish in color and acidic).

Level of nitrogen dioxide in Bangkok was found to be only about 0.02 mg/cu.m.(1 hour) as compared to 0.32 mg/cu.m. of the ambient air quality standard (as measured at five stations).

2.4 Ozone Ozone is the gas that forms from photochemical reactions, with precursors as nitrogen oxides and hydrocarbons, and sunlight as the source of energy which lead to the formation of ozone and other oxidized hydrocarbons. These photochemical oxidants cause eye irritations and plant damages. The problem occured in major cities such as Los Angeles and Tokyo.

Level of ozone in Bangkok, as measured at office of National Environment Board is lower than the ambient air quality standard (0.20 mg/cu.m, one hour average). Highest levels were found in March-May, when solar radiation is the strongest (0.15 mg/cu.m) but in rainy season (June-October) the levels declined to 0.05 mg/cu.m. Highest concentrations are always observed around noontime.

Climatologically, Bangkok is influenced by monsoon winds in all year round. During the Summer (February-September) the southerly wind prevails, and the rest of the year the northerly wind prevails, Theoretically there should not be excessive build up of pollutants in Bangkok for a verly large period of time.

There are no observable level of ozone in other cities.

2.5 Sulfur Dioxide Sulfur dioxide is the result of sulfur compounds in fossil fuels such as fuel oil or coal being combusted, or result from industrial activities such as sulfuric acid manufacturing plants. Sulfurdioxide is toxic and causes irritaions to respiratory systems as well as damages plants and properties. IN North America and Europe it causes acid rain which destroys forests and wildlifes.

Levels of sulfur dioxide in the ambient air of Bangkok was found to be very low. At four stations around Bangkok, the 24-hour average level is 0.03 mg/cu.m, much less than the ambient air quality standard of 0.30 mg/cu.m. The low level is probably the result of absence of home heating, and industries in Bangkok do not use much fossil fuels, but use electricity for power. However the trend may change in the future as the country is industrialized very rapidly.

Already there have been complaints from this gas from residents near factories and acid manufacturers due to plant damages and odor, thus there should be control measures to prevent the future problem.

2.6 Carbon Monoxide Carbon monoxide is the gas resulting from incomplete combustion of fuels, and is toxic gas which is colorless, odorless, and tasteless. It can combine with haemoglobin in the blood and cause oxygen insufficiency in persons who are exposed to high concentration, which results in dizziness and fainting. Carbon monoxide occurs in densely traffic areas.

The ambient air quality standard for carbon monoxide is 50 mg/cu.m. (for 1-hour average) and 20 mg/cu.m.-(for 8 hour average). Monitoring of carbon monoxide (CO) during 1983-1986 at stations in Bangkok indicates that there were no violation of ambient air quality standards for co. Levels remain around the same for the 4 year period, which may be explained by the fact that consumption of gasoline in Thailand has grown only ten percent during 1983-1986, as people preferred to use diesel and LPG for automobiles. These fuels produce less CO when being used in transportation.The levels are higher in winter (October-January) as the cool weather produces inversions and calm periods especially at nights and early morning.

2.7 Results of Monitoring of Ambient Air Quality Since the pollutants those were found in the ambient air at the permament monitoring stations at high concentrations are carbon monoxide and particulate matter, it is interesting to monitor near the major streets to be nearer to the sources of both pollutants, the motor vehicles.

Office of the National Environment Board has monitored levels of carbon nonoxide, particulates, and lead near major roads in Bangkok during February - March 1984 (which happened to be during the changing of several roads in Bangkok to one-way system), Levels of CO and particulate matter at some sites were found to be higher than National Ambient Air Quality Standards.

In 1985 there were 4 monitoring sites near major roads, and in 1986 and 1987, two sites each. Results which still showed violations of standards for particulate matter and carbon monoxide in some places.

Monitoring of Air Quality in other provinces has been performed since 1983, the cities of Haad Yai in the South (1983,1987), Chiang Mai (1983-1987), were found to have high concentrations of particulate matters and carbon monoxide. At Khon Kaen there was high concentrations of particulate matter. At Phuket the air quality is very good, with no pollutants exceeding standards.

Lead levels near roads were found to be lower than national standards (10 micrograms/cu.m.). The levels in Bangkok were less than 6, in Chiang Mai less than 3, Khon Kaen less than 2, and Phuket less than one microgram/cu.m.

Sulfur dioxide and nitrogen dioxide were not found in any significant concentrations anywhere, which indicates that the more immediate problem is on automobile emission rather than industrial sources.

However, the latest survey conducted by ONEB found that in Bangkok overall air pollution is worsening steadily and spreading to all the main business districts of the city. ONEB rated the capital's atmosphere as "dangerous" throughout 1990. The acceptable air quality index is set by ONEB at 100 anything above this figure is "bad" and below is "good". The citywide average air quality index in Bangkok reached 277 throughout 1989.

The ONEB also reported a worsening of air quality around the Patpong area off Silom road, where a recent investigation found an alarming concentration of small particles reaching 340, and carbon monoxide reaching 270 against the standard of 100.

In other areas around the city the air quality index is acceptable at about 90.5.

The ONEB named public buses a major source of air pollution, About 60 per cent of the Bangkok Mass Transit Authority (BMTA) buses' exhaust fumes exceed the standard according to the latest survey. In 1985 survey, only 25 per cent of 3,000 buses were reported to be emitting pollution fumes. With an average 10 per cent annual increase in all types of vehicles on Bangkok streets, pollution will get worse and worse.

Black smoke from diesel engine vehicles comprises mainly particles of dust and hydrocarbons which can be dangerous to human being. Not much attention is being given hydrocarbon substance since there is no study of its sudden toxicity apart from its potential to be a cancer carcinogan substance. Besides being a part of the black exhaust smoke, hydrocarbons can also come from small engine vehicles such as motorcycles and small four-wheel cars known as the Si Lor Lek.An increase of these small vehicles as a convenient transport service in sois or the main roads in traffic jams has led to an increase of hydrocarbons in the environment.

The standard measurement of 100 for used vehicle exhausts allows for 6 per cent carbon monoxide, 1,000 ppm (part per million) hydrocarbon, and 40 per cent for the Bosch system of black exhaust measurement.

The deterioration of air quality in Bangkok is also a result of high lead content in gasoline. Even the lead content in gasoline was reduced from 0.84 gram/litre to 0.40 gram/litre in 1984, it is still considered too high compared with other neighbouring countries. Hong Kong, Singapore and Malaysia had reduce lead content in gasoling to 0.15 gram/litre, and are also headed towards more rapid improvement in even lower lead contents in gasoline and lower sulfur contents in diesel oil.

2.8 Air Quality Standards

2.8.1 National Ambient Air Quality Standards

Pollutants	1-hr average value mg/m3	8-hr average value mg/m3	24-hr average value mg/m3	1-yr average value mg/m3	Methods of Measurement
Carbon Monoxide(CO)	50	20	-	-	Non-Dispersive Infrared Detection
Nitrogen Dioxide(NO_2)	0.32	-	-	-	Gas Phase Chemiluminescence
Sulfur Dioxide(SO)	-	-	0.30	0.10*	Pararosaniline
Suspended Particulate Matter (SPM)	-	-	0.33	0.10*	Gravimetric-High Volumn
Photochemical Oxidant(O_3)	0.20	-	-	-	Chemiluminescence
Lead(Pb)		-	0.01	-	Wet Ashing

Note : * = Geometric mean value.

Sources : (1) Standards: Notification of Office of the National Environment Board,No.2, dated November 6,B.E.2524. published in the Royal Government Gazette,Vol.98, Part 197, dated December 1. B.E. 2524 (1981) P. 4322-4323.

(2) Methods of Measurement : Notification of the Ministry of Science, Technology and Energy, issued under National Environmental Quality Act B.E.2518, B.E.2521, published in the Royal Government Gazette, Vol.98, I'art 197, dated December, 1, B.E. 2524 (1981) P.4299-4306.

2.8.2 Emission Standards

A. Industrial Emission Standards

In order to avoid industrial nuisance problems, the intensity of smoke at the mouth of the stack shall not exceed 40 percent of total blackness by the Ringlemann scale except for the short periods of time during starting of operation, soot blowing, or other malfunctions of the soot control system.

Penalty : According to Factory Act No.2, B.E. 2518 (1975) which rules that violator are subjected up to one month imprisonment or fined not more than 10,000 baht or both.

Source : Notification of the Ministry of Industry No.4, B.E.2514 (1971) issued under Factory Act B.E.2512 (1969)dated August 11, B.E.2514 (1971), published in the Royal Government Gazette, Vol.86 (Special issue) dated August 14, B.E.2514 (1971)

The Industrial Environment Division, Ministry of Industry has set up the emission guidelines for new industry or expansion or setting conditions after complaints.

The proposed emission standards are shown as follows :

Proposed Industrial Emission Standards by Industrial Environment Division, Ministry of Industry

No	Substance	Source	Proposed Standard Values
1.	Particulate	-Boiler & furnance	
		Heavy oil as fuel	0.3 g/Nm$_3$
		Coal as fuel	0.5 g/Nm$_3$
		-Steel manufacturing	400 mg/Nm$_3$
		-Cement plant and calcium carbide plant	400 mg/Nm$_3$
		-Rock and gravel aggregate plants (production capacity more than 50,000 ton per year)	400 mg/Nm$_3$
		-Other source	500 mg/Nm$_3$
2	Smoke opacity	Boiler and Furnace	not exceed 40% Ringlemann scale
3	Aluminium	Furnace or smelter	(dust)300 mg/Nm$_3$ (Al)50 mg/Nm$_3$
4	Alcohol	any source	0.05 lb/min
5	Aldehyde	any source	0.05 lb/min
6	Ammonia	gas plant	25 ppm
7	Antimony	any source	25 mg/Nm$_3$
8	Aromatics	any source	0.05 lb/min
9	Asbestos	any source	27 mg/Nm$_3$

No	Substance	Source	Proposed Standard Values
10	Arsenic	any source	20 mg/Nm$_3$
11	Beryllium	any source	10 mg/Nm$_3$
12	Carbonyls	Burning refuse	25 ppm
13	Chlorine	any source	20 mg/Nm$_3$
14	Ethylene	from production or by usage	0.03 lb/min
15	Ester	any source	0.05 lb/min
16	Fluorine	any source	0.3 lb/ton P^{2}O^5
17	Hydrogen Chloride	any source	200 mg/Nm$_3$
18	Hydrogen Fluoride	any source	10 mg/Nm$_3$
19	Hydrogen Sulphide	any source	100 ppm
20	Cadmium	any source	1.0 mg/Nm$_3$
21	Copper	any source	dust 300 mg/Nm$_3$ (Cu)20 mg/Nm$_3$
22	Lead	any source	dust 100 mg/Nm$_3$ (Pb)30 mg/Nm$_3$
23	Mercury	any source	0.1 mg/Nm$_3$
24	CO	any source	1,000 mg/Nm$_3$
25	SO^2	H^{2}SO^4 production	500 ppm
		Other activities;	
		- Bangkok and its vicinities	400 ppm
		- other area	700 ppm

No	Substance	Source	Proposed Standard Values
26	NO	Combustion source	1,000 mg/Nm$_3$
		HNO^3 production and others	2,000 mg/Nm$_3$
27	Nitric acid	any source	70 mg/Nm$_3$
28	Organic Material	any source	0.01 ld/min
29	Phosphoric acid	any source	3 mg/Nm$_3$
30	Sulfur trioxid	any source also in combination with H^{2}SO^4	35 mg/Nm$_3$ as H^{2}SO^4
31	Sulfuric acid	any source	35 mg/Nm$_3$

B. Motor Vehicle Emission Standards

Organization	Parameters	Emission Standards Measuring Systems	 Maximum Permissible Limit (%)	Measuring Methods (summary)
(1) ONEB (Office of the National Environment Board)	Black Smoke	Bosch or	50	1) At rapid acceleration under no-load condition to maximum rotaing speed. Use maximum value of the two measurements.
		Hartridge Bosch	52 40	2)On test bench, running with full-load at 60% of the maximum rotating speed. Use average valve of the two measurements.
	CO	Non-Dispersive Infrared Detection	6	1)Idling 2)Average value of the two measurements
(2) The Police Department	Black Smoke	Smoke meter	40*	At proper rotating speed
(3) Department of Land Transport	Black Smoke	Bosch or	50	1) The same as ONEB.in 1)
		Hartridge Bosch	52 40	2) The same as ONEB in 2)
	CO	Non-Dispersive Infrared Detection	6	The same as ONEB.

* Note : The emission standards and measuring methods for black smoke issued by the Police Department will be changed to be the same as ONEB's

Sources:

(1) ONEB

Standards :
- Notification of Office of the National Environment Board,Dated January 28, B.E.2531 (1988) published in the Royal Govenment Gazette, Vol 105, Part 73,dated May 5, B.E.2531 (1988) P.3679-3680
- Notification of Office of the National Environment Board. Dated December 14, B.E.2522 (1979) published in the Royal Government Gazette, Vol 97, Part 35, dated March 4, B.E. 2523 (1980) P.736-737.

Method of Measurement
- Notification of the Ministry of Science, Technology Measurement and Energy, issued under National Environmental Quality Act. B.E. 2518 (1988) p.3665-3666
- Notification of the Ministry of Science, Technology and Energy, issued under National Environmental Quality Act. B.E.2518, B.E. 2521 dated February 7,B.E.2523(1980), published in the Royal Government Gazette, Vol.97, Part 35, dated March 4, B.E.2523 (1980) P.715-718.

(2) The Police Department :
- Notification of the Police Department issued under the Announcement of the Revolutionary Party No.16, dated February 3, B.E.2527 (1984), published in the Royal Government Gazette, Vol. 101, part 20, dated February 16, B.E.2527 (1984) (special issue) p.4-5.

(3) Department of Land Transport :

- Notification of the Department of land Transport issued under Land Transport Act B.E. 2522, dated September 9, B.E.2531 (1988)

C. Boat/Ship/Vesel Emission Standards

Black smoke emissions shall not exceed 40% by Bosch or 52% by Hartridge System when measuring at 2/3 of maximum rotating speed.

Penalty: Two handred baht for first violation and two thousand baht for second violation.

Source : Notification of the Harbour Department No.177/1984 dated August 3, B.E. 2527 (1984), effective January 1,B.E. 2528(1985)

2.9 Government Policy on Emission Control

According to the pollutants from motor vehicles include CO, $H^{3}C$ and suspended particular matters were found to be higher than National Ambient Air Quality standards, the ONEB is now revising the Emission Standards for Automobile in order to reduce air pollution.

Besides this, in the near future the Department of Land Transport has set up a plan to subcontract a number of private firms to examine the condition of engines at the time the owners have to continue the annual registration fee whether the emitting CO, $H^{3}S$ are higher than standard, if not the automobiles will not be allowed to continue the registration.

3. Noise Noise problem in Thailand results from traffic and industry. At the present there is no community noise level standards, but there are vehicles' noise emission standards as well as working standards.

Office of the National Environment Board(ONEB) monitored noise levels at many locations near busy roads in Bangkok and other cities . Many of the locations were found to have noise level (L_{eq} (24)) greater than 70 dBA, which is the US.EPA standards for long-term hearing protection. This results from noise emitted from trucks, buses, and motorcycles (table 3). Long-tail boats also cause loud noise.

Table 3 : Percentage of Motor Vehicles that Violate Noise Standard (Standard : 100 dBA of 0.5 metre)

	Province	Type of Motor Vehicle	Motor Vehicles that Violate Noise Standard			
			1983	1985	1986	1987
1.	Phuket	Motorcycle	-	-	5.0	-
		Diesel Car	-	-	58.2	-
		Gasoline Car	-	-	39.6	-
2.	Had Yai	Motorcycle	53.3	10.5	-	-
3.	Chiang Mai	Motorcycle	26.0	2.7	-	-
4.	Khonkaen	Motorcycle	-	8.3	-	-
5.	Cholburi	Motorcycle	-	10.4	-	-
6.	Suratthani	Motorcycle	-	-	-	1.3
		Mini Bus	-	-	-	2.8
		Diesel Car	-	-	-	29.7
7.	Bangkok	Motorcycle	-	-	24.6	-
		Bus	-	49.2	-	-

Source : office of National Environment Board

4. Water Quality

4.1 Fresh Water In Thailand, water is divided into 2 catagories i.e., inland fresh water and seawater in Gulf of Thailand and Andaman sea. In nature, fresh water and seawater are interrelated in hydrologic cycle. Thus, rainfall is a major source of inland fresh water. According to geographical configuration of Thailand, we can divide watershed into four areas as follows :

1. Northern Watershed Area : Rainfall in this mountainous area converges to form many rivers draining into central part of the country, which contribute watershed area of Choo Phraya River.
2. Central Watershed Area : Comprising low-land area in conjunction with northern watershed area. Central watershed area is the origin of some short-ranged rivers, such as PaSak river, Bangpakong river. These two mentioned areas are the origin of rivers draining into inner part of Gulf of Thailand, important ones are Chao Phraya river, Ta Chin river, Bangpakong river, Mae Klong river :
3. Northeast watershed area : Slope of this area is the origin of river draining into Khong river. These are Moon river, Chee river.
4. Coastal watershed area: Located in the east and south. It is the origin of short-ranged rivers draining into the sea, for instance, Tapi river.

Apart from rivers, there are also many lakes scattering in various parts of the country, i.e., Lake Songkla.

In later period of time, construction of dams for the purposes of electric power generation, agriculture has established a number of reservoirs, i.e., Bhumiphol dam.

A portion of rainfall in watershed area may lead to ground water, another source of fresh water, through the process of supage.

Table : Number and Volume of Important Surface Water of Thailand

Region	River		Reservoir		Natural Impoundment	
	No	vol(Mil m^3)	No	vol(Mil m^3)	No	vol(Mil m^3)
1. Northeast	3	26,558	552	6,231	1	193
2. North	6	23,175	44	48,723	1	34
3. Central	6	29,720	27	18,780	1	156
4. East	3	3,747	19	333	-	-
5. South	2	6,795	6	6,708	1	53
Total	20	89,995	648	80,775	4	436

Source : Report on Environmental Situation in 1980, National Environment Board.

Cause of water pollution in Thailand has become evident during the last one or two decades. The major cause comes from rapid development in industry, agriculture and the establishment of densely populated communities. In old days, wastes dumped into the water were not of great amount. Nature had an ability of self-purification or pollutants were diluted to an extent that problem could not arise. Dirtiness in water comes mainly from human communities.

Afterwards, a large number of industries have been established, their wastes are discharged into the water. As a consequence of industry development, a hugh amount of labour is required and inevitably bring about community expansion. All these factors together yield an increase in water demand and water pollution follows. This situation occurs rapidly in various locations and resulting in an increase of deteriaration of natural waters.

Chemical fertilizers and pesticides are essential for agricultural development so as to increase output. Parts of fertilizers and pesticides residue is leached into water body. The problem of water pollution has threatened various users in different purposes where different water quality is needed, for instance, domestic water supply, animal husbandry and various kinds of industry. They normally obtain water from the same source endangered with pollution. The question comes where they can obtain water of agreeable quality and sufficient quantity.

In Thailand, sources of water are fresh water and seawater, both have been polluted. Changes in water quality fall under three main respects, i.e., chemical, physical and biological.

4.1.1 Chemical Properties Lowering of Dissolved Oxygen (Do) in various water body is a phenomenon which clearly indicates the pollution. Cause of lowering DO is the excessive discharge of organic matter into water. Causes of this type of pollution come from agricultural products processing factories and domestic areas. It can be claimed that in most cases, releases of these materials into water are of non-point source type, since factories and domestic areas are usually located on river bank. Bacterial decomposition of organic matters causes the lowering of DO. If anoxic condition prevails, accumulation of H_2S at bottom of water body exists, water has an agreeable odour.

Problem of lowering of DO in some important rivers are described below.

Chao Phraya River : The largest river in Thailand originated in the north of Thailand, and flows to the Gulf of Thailand passing through more than 9 major cities and provinces including Bangkok. Many industries have been built on the bank of this river (more than 60 factories). Waste loading of the river is more than 400,000 kg BOD per day which lowers water quality of the river.

In clean water quantity of DO is at least 7 milligram/litre. According to the National Environment Board, during 1981-1985 DO content in lower part of Chao Phraya river (Km 7-62) is under the standard set by NEB at 2.0 mg/l, ie.,1.1-1.5 mg/l during 1981-1984 and declining to 0.29 mg/l in 1985. The DO content in Choa Phya river is critically low in the area between Rama I Bridge and Bangkok Port with BO content of only 0.5-1.0 mg/l during 1978-1986.

Mea Klong River Originated in Karnchanaburi Province and flows to the Gulf of Thailand in Samutsongkhram. It passes many big cities such as Karnchanaburi, Ratburi and Samutsongkhram. More than 30 factories are on the bank of this river and discharge wastewater loading is more than 7,000 kg BOD/day. During last decade, this river has been heavily polluted by wastewater discharges from sugar refineries. Average DO in summer is 1 mg/l. Later, Departmentof factory, Ministry of Industry had created water treatment plants, this has improved the situation with average DO being increased to over 4 mg/l.

Ta Chin River : A tributary of Chao Phraya river. DO had been lowered in Suphanburi province and its estuary. In 1982, DO reached a minimum level of 0.87 mg/l in Nakhon Phathom province. Later in 1983-1984, DO in the estuarine area was lower than 2 mg/l for the whole year indicated that the water quality of Ta Chin river was steadily deterioated.

Bangpakong River : A short-ranged river, water quality is at a satisfactory level, with average DO of 4 mg/l.However, water quality when passing through Chacherngsao province shows a tendency of having lower quality.

4.1.2 Physical Properties It is found that amount of suspended particle in rivers is high. In rainy seasons, various rivers usually carry high amount of supended particles due to erosion of river bank. There is also problem of pumping excessive amount of underground water which causes Bangkok's sinking of land.

4.1.3 Biological Properties Determination of coliform bacteria is undertaken. It is frequently found that water in domestic areas often contain such organism at high level, which indicated low efficiency of domestic waste treatment system.

4.2 Seawater Thailand has two coasts; the Gulf of Thailand and the Andaman sea coast. One curves around the scooped out shore of the Gulf of Thailand and has a length of 1,870 kms. The other lines the shore of the Andaman Sea of the Indian Ocean and has its length of 800 kms extending northwards from Malaysian border to the Burmese border.

The Upper/Inner Gulf of Thailand is a receiving area for all kinds of waste from the rivers. Even the fast deterioration of fishery resources in the Inner Gulf of Thailand is obviously caused by overfishing. However, the change of water characteristics due to dissimination of various pollutants may be another factor for the resource deterioration.

The increasing trend of heavy metal contaminations in estuarine environment of the Inner Gulf of Thailand is obvious. Samples of waters, sediments and aquatic fauna were collected monthly from the mouths of the Bangpakong River, the Tachin River, the Maeklong River, the Petchburi River and the Pranburi River in April 1979 to March 1980 and analyzed for lead, zinc, copper, cadmium and mercury contents. The results illustrated the annual variations of the heavy metal concentrations in waters and sediments. The concentrations of Pb, Zn, Cu, Cd and Hg in water, sediment and aquatic fauna are shown in Table . The water and sediment concentrations of those heavy metals were considered to be in the range of safe levels. However, the high concentrations of heavy metals, particularly Pb and Cd, in aquatic fauna, together with the high values of bioconcentration factors, posted a warning sign of hazardous effects on aquatic fauna and ecosystem.

Table : Variations of the heavy metals concentrations in water, sediment and aquatic fauna

Parameters	Concentrations of Heavy Metals		
	water (ug/l)	Sediment (ug/l)	Aquatic fauna(ug/l)
Lead	9.6 - 12.0	13.1 - 25.7	12.7 - 33.7
Zinc	2.2 - 6.4	28.7 - 54.4	8.4 - 17.2
Copper	14.6 - 27.1	5.4 - 13.3	3.9 - 11.7
Cadmium	1.9 - 2.0	0.12 - 0.26	0.9 - 3.7
Mercury	0.24 - 0.38	0.007-0.017	0.012- 0.051

The Eastern Seaboard Environmental Management Plan (NEB 1986) revealed that existing coastal water quality in Chonburi Bay, Pattaya Bay and Ban Phe Bay is very poor and requires immediate actions for cleaning up because it is jeopadizing the principle beneficial uses of these areas. Highconcentration of coliforms and heavey metals in Chonburi Bay may affect the productions of shellfish. Water quality of low aesthetic values in Pattaya Bay and Ban Phe Bay is jeopadizing the existing tourism activity and decreases the opportunity for tourism promotion. It was found that lead and zinc have trend in high concentration according to the monitoring data of the Upper Gulf in 1982-1985 (NEB 1986,) however all the heavy metal concentrations is still within limits not exceed the US.EPA standards.

Between March 1985 and May 1986, samples of subsurface water (1m.) and surface sediments were collected from stations on the Upper and Lower Gulf of Thailand. These have been analysed by fluorescence spectroscopy (UVF) in order to provide information on the levels of hydrocarbons generally present in the Gulf. It was found that all samples were contaminated with petroleum hydrocarbons. Total hydrocarbon concentrations of water samples from the Upper Gulf ranged from 0.65 to 8.3 ug/1 crude oil equivalents, with the mean of 2.3 ug/1. In the Lower Gulf the range of hydrocabon found was 0.07 to 6.6 ug/1 and the mean was 1.3 ug/1.

Sedimentation rates in the Upper Gulf of Thailand were studied by using the Lead-210 method. The values were from 3.3 - 8.9 mm/yr. Sediments in the lower part of the Upper Gulf appear to have lower sedimentation rates. Data suggest that most of the sediments transported by the Maeklong, Tachin, Chao Phraya and Bangpakong Rivers accumulates in the northern part of the Upper Gulf.

Contamination of organochlorine insecticides and PCN's in 3 bivalve species of mollusc and sea water from the east coast of the Upper Gulf of Thailand in the area of Cha Choeng Sao and Chon Buri were studied from 1982-1983. Ninety-six samples of green mussed (Mytilus viridisL), 64 samples of oyster (Crassostrea commercialis) 28 sample of cockle (Anadara granosa) and 54 samples of sea water were extracted and quantitated by gas chromatograph. The results showed that DDT, BHC, dieldrin, endrin and linndane were found in those mollusc samples. DDT was also found in sea water samples. The level of contamination of these insecticides were lower than 0.01 mg/kg. Heptachlor, aldrin, chlordane, endosulfan and PCB's were not detected in these samples.

In 1982-1983, a monitoring work was conducted for coastal water quality in Andaman sea coast. Water samples were taken at the surface, mid depth and substrate waters along the Andaman sea coast in the northeast monsoon period. The results are shown in Table .

Table : Level of some parameters along the Andaman sea coast

Parameter	Concentrations/values
Salinity (%)	31.10 - 34.50
Dissolved oxygen (mg/l)	2.05 - 7.12
Nitrate (ug-at NO-N/l)	ND - 13.90
Phosphate (ug-at P^3 O-P/l)	ND - 1.54
Nitrite (ug-at NO$_2$ - ^{4}N/l)	ND - 7.00
Temperature (c)^2	20.50 - 30.60
pH	7.90 - 8.40
Total Suspended Solids (mg/l)	0.45 - 20.80
Transparency (m)	2.50 - 29.00

In the Andaman sea, Phuket Island is considered a valuable tourist resort which always has conflict with mining and industrial business especially on the matter of environmental issue. Coastal water quality along the west coast has been monitored from 1985 up to present. The results are shown in Table

Table : Water quality of West Coast of the Phuket (NEB 1987)

Area/Bay Parameters	Nai Yang Maikhao	Patong(North&South) Koh Poo,Laem Mai Ngang Kata Noi (South)	Patong Karon Kata Yai	Naihan
Temperature (c)	27.8-30.0	27.0 - 29.00	-	-
pH	8.2- 8.4	8.2 - 8.40	-	-
Salinity (ppt)	32.0-34.0	31.0 - 34.00	-	-
Transparency(m)	8.0-13.00	7.5 - 17.00	7.5-18.0	-
Do (mg/l)	4.8- 6.4	5.3 - 6.90	-	-
Total Coliform (MPN/100 ml)	110-<2,400	-	5-<2,400	-
Floatable oil/ grease	0.1	-	0.1-0.005	-

Thailand Development Research Institute (TDRI) has gathered information available in Thailand which that the estuaries of the Chao Phraya and Tachin rivers are characterized by relatively low DO levels. Other estuaries, including those of the Petchburi, Chanthaburi, Tapi, Lang Suan, Pak Phanang and Chumphorn, also show evidence of some pollution, but at a much lower level than either the Chao Phraya and Tachin. Generally, the DO levels were high, with an average value of 7.15 mg/l along the East Coast of the Gulf of Thailand, and a minimum value of 2.3 mg/l. These results suggest that the current organic load discharged by the major rivers is being assimilated quickly into the marine environment.

Heavy metals are a different matter, since they are not broken down easily like organic compounds. The concentrations were generally higher in river sediments, for example lead was 1,000 to 2,000 times more concentrated in the sediments of the Bangpakong, Maeklong, Petchburi Pranburi and Tachin rivers than in their waters, while zinc was 6,000to 20,000 times as concentrated in the sediment. The differences were lower for some other heavy metals, such as copper (300 - 600 times), cadmium (60 - 130 times) and mercury (20 - 80 times). In general, heavy metal concentrations are still within the safety limits, although occasional local "hot sports" of mercury have been found, probably because of illegal dumping activities.

The mercury concentrations found in marine animals are generally below the safety limit (0.5 mg/kg) set by the US Food and Drug Administration (FDA). Of 221 specimens collected, only two showed the highest mercury value of 0.227 mg/kg, and only 3.6 percent of the samples showed mercury levels higher than 0.1 mg/kg.

As far as pesticide concentrations in the Gulf of Thailand are concerned, the results from the river mouths were generally very low. However, one value for DDT was observed which was 1,400 times higher than the safety limit. Again, it is thought that this may result from illegal industrial dumping. DDT was detected in 12 samples out of 100 at the level of 0.002 to 0.003 ug/l, exceeding the standard of 0.001 ug/l.

The situation could easily have been worse than the present data show it to be. But there is no room for complacency. One phenomena which has been of particular concern in coastal areas, has been the "red tide" condition, thought to result from the excessive nutrients and inorganic pollutants which wash down into the estuaries and coastal areas. Red Tides have been a major problem for the mariculture industry, which is described in the section of Plankton Bloom and are considered to be the major cause of the mass mortalities affecting green mussel farms.

As far as the Andaman Sea is concerned, there is less information about the prevailing pollution levels. In part, this reflects the fact that the pollution problems here are essentially very localized, including sediments and slimes from the tin mining industry in the Phuket region and centain amount of sewage and oil pollution.

5. Waste Situation

5.1 Bangkok Metropolitan The World bank estimated waste situation during 1985-1997 as follows.

Table : Waste Situation of Bangkok During 1985-1997

Year	No.of Population (Million)	Waste (Kg/person/day)	Total Waste (Tons/day)
1985	5.3	0.83	4,308
1989	5.6	0.93	5,157
1993	5.9	1.04	6,136
1997	6.3	1.18	7,434

Source : World Bank

In September 1989 the rubbish and refuse from more than 5.4 million population within 1569 square kilometers was 4,225 tons per day with the anticipated growth rate of 4-6% per annum. Average solid waste would be 0.8 kg/person/day. But BMA has collection capacity of only 4,100 tons per day.

It is seen that in 1997, total waste of Bangkok Metropolis is estimated at 7,434 tons per day , the over capacity has to open dumping and open burning.

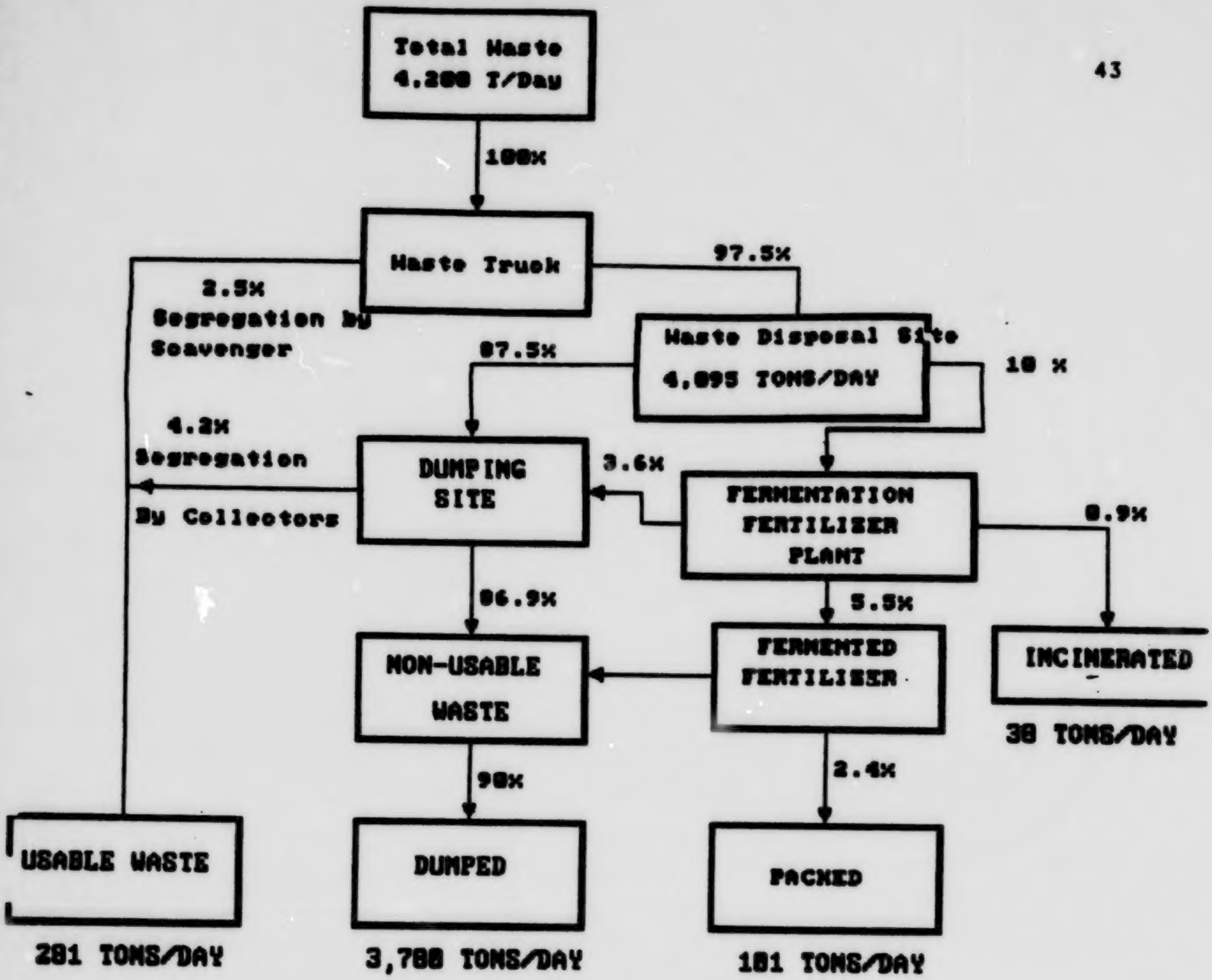
Total Waste
4.200 T/Day
100%
Waste Truck
97.5%
2.5%
Segregation by
Scavenger
Waste Disposal Site
4,095 TONS/DAY
87.5%
10 %
4.2%
Segregation
By Collectors
DUMPING
SITE
3.6%
FERMENTATION
FERTILIZER
PLANT
0.9%
86.9%
5.5%
NON-USABLE
WASTE
FERMENTED
FERTILIZER
INCINERATED
38 TONS/DAY
90%
2.4%
USABLE WASTE
DUMPED
PACKED
281 TONS/DAY
3,780 TONS/DAY
101 TONS/DAY

Figure : Flow Diagram of Waste in Bangkok

It is seen in the flow diagram in Figure that from 4,200 tons per day waste collected by Bangkok Metropolitan Administration (BMA), 4,095 tons (97.5%) will go to waste disposal site, whereas 105 tons (2.5%) will be segregated by scavengers to be used as usable waste. From waste disposal site, the majority of waste will go to dumping site, from which usable waste will be segregated by collectors wheras non-usable waste will be dumped to dumping area. The remaining part of waste from waste disposal site will be transfered to fermentation fertilizer plant, after which it will be transformed to fermented fertilizer, incinerated or dumped to dumping site.

The problems encountered by BMA regarding waste are as follows:-

1. Transportation System : At present, due to insufficiency of waste trucks, collection and transportation to disposal site have to be done continuously by waste trucks. This means collection capacity of the system has been reduced significantly.

2. Accessity Problem : Some households in Bangkok are located in areas where accessity is quite limited such as households in congested areas or those along the banks of river or canals.

3. Disposal Problem : Presently, BMA employs 2 methods of waste disposal,i.e., composting through fermentation fertilizer plant and open dumping. At this moment there are 4 fertilizer fermentation plants in Bangkok with combined capacity of 1,280 tons per day. However, since these plants were built more than 10 years ago, the

operating performances are much lower than their nominal capacities. There are no incineration plant in Bangkok at this moment.

Regarding open dumping, there is problem of accumulation of waste to the level over acceptance capacities of dumping site. This causes unpleasant odours and proliferation of contagious diseases.

5.2 Upcountry Unlike Bangkok Metropolis, normal waste is still under control in upcountry at this monent. The problem that they are facing however is hazardous wastes.

A hazardous waste is any waste or combination of wastes which, because of its quantity, concentration, or physical, chamical or infectious characteristics, may

1. cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of, or otherwise managed.

Thailand is in the period of unparalled economic development and industrialization. National industrial production capacity has doubled in the past seven or eight years, whereas economic growth is currently estimated at 10 per cent per year. New plants are more complex and sophisticated whereas their product-stream are becoming more inclusive. For example, Thailand will soon have production facilities for the conversion of petrochemicals into virtually every related consumer product through its NPC-1 and NPC-2 projects.

Along with growth has come the threat of pollution of the environment by hazardous chemicals. Between 1972 and 1982, the number of registered chemical plants using and disposing of toxic materials doubled from about 300 to 600. The rate of production of non-recyclable hazardous wastes will grow to almost two tons per year in the early 1990's.

In 1986, approximately 86,000 firms were registered with the Department of Industrial Works, Ministry of Industry, and an additional 314 firms were listed with the Industrial Estate Authority of Thailand (IEAT). Based on experience in other countries, however, most of the hazadous wastes of serious concern are generated by a relatively small percentage of these industries.

Significant amounts of hazardous wastes are also commonly generated by activities not regulated by Ministry of Industry. Electrical utilities (Polychrolinated Biphenyl or PCB), hospitals and laboratories (infectious wastes), marine and harbour activities (oil) and municipal waste (oil, solvents, cosmetics, etc.from individual households also contribute significant quantities.

Municipal solid waste disposal sites, although not intended as depositories for hazardous wastes, nevertheless contain a measurable component of hazardous materials which constitute a pollution threat to the environment. The municipal solid waste stream generally receives commercial and industrial waste as well as normal household wastes. All of these materials, which undoubtedly includes quantities of hazardous wastes are combined for disposal. With few exeptions, the municipal solid wastes are disposed by open dumping, often accompanied by burning. In most areas this results in obvious environmental impacts of air and water pollution as well as other public health problems due to the presence of disease vectors. Small amounts of usable materials are salvaged prior to discard from homes, shops, and industries. Additionally, collection crews and scavengers at disposal sites perform further separation activities.

Some hazardous waste generation will be heavily affected by future increase in energy consumption (eg.coal and lignite mining, petroleum industry, gas and electricity utilities) and others will be almost totally dependent upon future world market demand for minerals (e.g. tin mining, processing or smelting). Growth of activities aimed at satisfying consumer demand will tend to be linked to population growth and general future affluence levels.

It is expected that hazardous wastes will grow from 1.151 million tons per year in 1986 to 5.993 million tons per year in 2001 as shown in Table .

Table

PROJECTED HAZARDOUS WASTE QUANTITIES BY WASTE TYPE

Waste Type	Hazardous Waste Quantities, Thousand Tonnes /year			
	1986	1991	1986	2001
Oils	124.19	219.47	386.89	686.36
Liquid Organic Residues	0.19	0.31	0.52	0.88
Organic Sludges & Solids	3.74	6.67	11.95	21.53
Inorganic Sludges & Solids	11.70	19.25	32.04	54.08
Heavy Metal Sludges & Solids	823.87	1,447.59	2,536.03	4,418.03
Solvents	19.78	36.16	66.53	124.31
Acid Wastes	81.05	125.43	196.51	311.71
Alkaline Wastes	21.95	34.24	54.02	86.20
Off Spec Products	0.01	0.03	0.05	0.11
PCB	2.46	*	*	*
Aqueous Organic Residues	0.12	0.24	0.50	1.04
Photo Wastes	8.82	16.35	30.40	57.81
Municipal Wastes	7.23	11.79	19.09	31.09
Infectious Wastes	46.67	76.08	123.22	200.70
Totals	1,151.73	1,993.60	3,458.76	5,993.84

* Total existing quantity estimated at 2,468 tonnes. It has been assumed that no new PCB containing materials were imported to Thailand after the mid 1970's.

OPPORTUNITY FOR CANADIAN INVESTORS

Forest : Since the government policy of breaching all Forestry concession was valid, the urgent project is certainly the reforestation policy, Canadian investors should :

1. Introduce Reforestation project in denuded forest as a turn key project to Thai govenment or join a venture for this investment. Meanwhile the Restoration Project for the Degraded Reserve Forest will be the same attractive project to Thai government.
2. Introduce plantations of specific woods or plants like Eucaluptus for paper - pulp industry, wood-chip for export, teak wood and hardwood for furniture industry, etc.
3. Mangrove along the coasts in the eastern and southern regions are under critical situation since it is converted for shrimp farming and simultaneously destroy the ecology of the marine life. Mangrove survival certinly needs urgent activities and know-how. Canadian investors can make a proposal of mangrove survival technology to the government.

Water : The rapid growing communities in the big cities have problem on clean water supply, waste water, sewerage system. Canadian investors may concentrate on :

1. Consultancy Service for Waste Treatment Projects to the government organization in the growing cities like Pataya, Rayong, Chiengmai, Phuket, Samui Island including Bangkok

2. Investment on Clean Water Supply for the developing communities like Pataya, Lamchabang, Mabtapud, Phuket, and new established private industrial estates.

3. Investment on Waste Water Treatment Plants in the industrial estates both organised by government and privates.

4. Turn key project of small scale waste water treatment facilities for high rise buildings in city area, which in the near future will be enforced by law to be a built-in facility of every high rise building and big complexes.

Solid Waste : For the time being the severe problem is in Bangkok only, but however the other big cities like Chiengmai and Nakon Rajasima,Pataya, Rayong or even on a small tourist resource like Samui island are simulating the same problems. The investors should consider :

1. Investment on turn key Composting Plant and Incinerators for BMA since the Landfill Decomposition will be outbalanced by the expensive land cost.

2. The garbage trucks are needed to boost the capacity of collection. An integrated system of collection and decomposition of garbage will be BMA's great interest.

3. Market study on investment of the above 2 aspects for the other big cities will render a good future opportunities.

Air and Noise : The significance concentrates in Bangkok. Mostly from automobiles which exactly are public buses of the Bangkok Mass Transit Authority. The opportunities are

1. New engines utilising the natural gas with easy term of payment should be of BMTA'S interest (365 buses are over 12 years; 1,942 over 10 years, 1,119 over 8 years, and 900 under 8 years)

2. Electric train for the sky train project is a nugget for Canadian investors since the Canadian Lavalin has nearly gained the agreement for the construction of the Express Way and Rapid Trasit Authority's sky train project, the other investors should watch for the future extension of the skyway network after the first phase is finished.

3. Air purifier for home use which is suitable for the households and offices in the polluted area is a prospect consumer goods for Canadian to study and act quickly.

GENERAL SAFETY SURROUNDINGS

Situation and Suggested Solution for Fire Problem

Bangkok Metropolis

Current Situation Bangkok is presently growing rapidly is terms of population and households. Bangkok presently has total area of 568,737 squarekilometers with population of 5,461,985 persons. There are 958,926 buildings comprising 603 buildings of 5-10 floors, 293 buildings of more than 10 floors,345 gas stations, 9 gas depots,105 entertainment buildings, 297 hotels and 532 engested communities.Consequently,there is a tendency of increase in fire incidents as shown in the following table.

Table : Fire Incidents During 1985-1988

Year	Namber of Incidents	Damage(Mil.Baht)	Death
1985	1,394	244.2	24
1986	255	119.1	30
1987	485	111.3	7
1988	554	298.8	39

There is a tendency of increase in population density and number of high-rise buildings in Bangkok, especially in 1990. This is due to sharp increase in costs of land and the immigration of population from upcountry to Bangkok which results in higher demand for households. Therefore, fire protection measures are necessary for this kind of situation However, there is problems of shortages of manpower and equipment to protect fire. Accoding to international standard, ratio of fire manpower and equipment must be as follows.

1.One fireman for every 1,000 population or it means 5,000 fire personels in Bangkok, compared with 2,663 persons in vality.

2.One standard fire fighting track for every 10,000 population, or about 500 units in Bangkok compared with 232 units at present.

3.One fire brigrade stations for 20 square kilometres area, or 80 stations conpared with 3.4 stations at this moment and going to increase to 48 stations.

Apart from insufficiency of fire fighting resources there is also problem of detorioration of fire fighty equipments due to it's long service life.

Suggested Solution

The fire Brigrade Police has adopted policy to suppress fire occurences to be under 73 incidents during 1988-1991 with budget for equipment purchase as follows.

Year	Budget (Million Baht)
1988	67.50
1989	100.53
1990	111.68
1991	62.70
Total	342.67

	Item	Quantity	Estimate price (Mil.Baht)/unit
1.	Extension Ladder Fire Truck Min 100 Ft. Height	2	15.0
2.	Snorkle Min 100 Ft Height	2	15.0
3.	Snorkle Min 75 Ft Height	7	8.5
4.	Chemical Fire Truck 1,000 kg.with Pump	7	5.5
5.	Water Tender 10,000 Litres	25	2.3
6.	Electric Lighting Truck	7	2.5
7.	Fire Boat 26-30 Ft.	8	3.0
8.	Fire Fighting Truck	7	4.0
9.	Water Pump Extinguisher	40	0.3
10.	Air Cushion	3	0.9

Up Country

During 1978-1987, there were 17,795 fire incidents in upcountry resulting in 603 wounds and 467 deaths with damage of 10,461.35 million Baht. Moreover, there were untangible losses such correction as psychological and other opportunities losses.

Correction Measures

Ministry of Interior has set plans (1990-1992) for fire protections by providing 1799 fire fighting equipments to 728 fire fighting units for the whole country, with total budget of 1,843 million Baht as follows.

Item	Quantity	Price/Unit (Million Baht)
1. Extension Ladder Fire Truck	17	13.0
2. Water Tendor Fire Truck	504	1.7
3. Fire Boat	20	2.5
4. Snorkle	494	1.1
5. Standard Fire Extinguisher	293	0.23
6. Small Fire Extinguisher	221	0.19
7. Truck	218	0.25
8. Flat Boat	32	0.23

MOTORCYCLE RIDERS IN BANGKOK

For those who are waiting for the bus on the street corner of Thailand, it is easy to recognize that the motorcycles are a common mean of people's transportation widely used in Thailand along with buses and private cars. On the other hand you will be astonished to see so many people riding on one motorcycle without wearing helmet.

Within these one or two decades, registered-vehicles and motorcycles have tremendously increased following the development of the road network and consequently enhancing slightly the number of traffic accidents because of lack of appropriated safety measures.

Motorcycle situation

Nowsaday it becomes clear that motorcycle keep the predominant position as the people's transportation means among Thai people for commuting to the offices and schools with the family members. This situation depends on the following items.

1. Number of registered motorcycles occupies 56% within all registered vehicles and this number increases by 16% per year.

2.The traffic volume is charactered by two peak periods in the morning and in the evening. During these peak hours the traffic volume of motorcycle can exceed the one of other vehicles.

3.Female and children riders in the peak period shows high ratio than other period.

Number of riders

The number of riders per motorcycles in the local region (1.3-1.6 person/motorcycle) is larger than in Bangkok area(1.2-1.4) to compensate the lower service of the public transportation in local regions. By a reference survey in Bangkok area this ratio 1.9 for taxi, 1.7 for samlors and 1.3 for motorcycle (only motorcycle includes drivers.)

The maximum number of riders on a motorcycle reach 6 person. (even 7 person was informed)

Helmet ratio

The persent helmet ratio over all riders are estimate as below.

local region	less than 10%
Bangkok suburban area	20-40%
Bangkok urban area	40-60%

Both the ratio of riders wearing helmet and its trend of variation per year in Bangkok area are clearly higher than in the local regions. An increasing trend of the ratio of the riders wearing helmet in Bangkok area is estimated 5-7% per year. As the number of riders per motorcycle increases, the helmet ratio decreases according to following results.

for 2 riders : half of 1 rider ratio
for 3 riders : half of 2 rider ratio

It is natural that drivers shows a high ratio (30-70%) and pillion riders a low ratio (10% or less)

Distribution among male, female and children riders

Few ladies drive motorcycles in Bangkok area (nearly 0%) but it seems that this number increase in the local regions. The interview survey in Songkhla shows 10% female drivers. Sometimes in the morning and evening peak hours, female and children pillion riders occupy more than 50% of the total number of pillion riders.

Statistics of Road Accident in Bangkok Metropolis
1975-1988

Year	No.of Accidents	The Injured	The Dead	Damaged Property(1,000B.)	
				Government Property	Private Property
1975	6,721	3,051	350	404	10,624
1976	7,965	3,628	403	377	11,999
1977	10,482	4,751	474	1,460	17,288
1978	11,980	4,844	534	1,910	22,009
1979	12,045	5,032	571	2,577	26,657
1980	11,190	4,585	624	3,984	31,676
1981	11,602	4,542	605	3,153	27,862
1982	13,160	4,698	600	1,376	27,257
1983	13,674	4,551	708	1,496	21,410
1984	14,092	4,672	736	2,357	26,926
1985	14,295	4,330	657	3,062	27,508
1986	16,069	5,139	675	2,519	31,647
1987	19,745	6,333	752	4,274	50,641
1988	31,175	9,565	817	6,182	70,320

Source : BMA

INDUSTRIAL INJURIES

The industrial injuries in Thailand is concentrate in Bangkok since it is the center of many types of industries,the number of employees entitled to compensation is nearly the same as the number of those entitled in the five satellite provinces. Accounting all 24 provinces in the Central region the employees entitled to compensation fund is about 80% of those under the compensation fund by the reason that it is the center of all industies in Thailand.

In 1988 the total establishments was 149,611 with the population of 2,494,702 employees, the exempted control of the Labour Compensation Law is the size of establishments under 20 persons containing 131,595 establishments or 87.96% with population of 587,904 or 23.57% of total labour force. Among the sizes under control of the Labour Compensation Law, the biggest group of establishments was the smallest size of 20-49 persons with 11,260 establishments or 7.53% with population of 13.39% total labour force. The biggest group by the population was the size over 999 employees which contained the population of 542,821 or 21.76% of total labour force but only 0.12% of establishments.

General Situation

Since the development of Thai industries in the recent years have grown rapidly with the unexpected rate. The new technologies have been employed for the production process while the development of training and education of the protection of hazard is not introduced to the investors in the matching rate as it is perceived from the media very often. Most of the injuries are caused by the lack of wareness of safety of the executives who are responsible meanwhile the labours are not wakened to self safety as it should be.

As a matter of fact all accidents are initiated by the human-own activities and the surroundings of working conditions which indeed are not out of control unless those involved are not aware of the safety of themselves and the communities, wholesome environment should be promoted for the sake of the organization's benefit. The employer should educate and train his employees to learn the safety of working conditions and pinpoint the disadvantages of the accidents tend to be occured in variable cases. In the same time the two way communication concentrating on the safety descriptions on jobs should be applied so that the employer can solve the problems before hand which is worthier than confronting the confounded cases.

Injuries in 1988

Among the 149,611 private establishments in 1988 handling 2,494,702 employees , there were 18,016 establishments under the compensation law covering 1,906,798 employees insured by the government compensation fund. The occupation injuries were reported at 55,966 cases among which were examined and entitled to compenstion Baht 362.62 million by 49,874 cases or 89% of reported caes . The rate of injuries would be 2.6% of total employees under the government compensation fund. Those failed to compensation was 6,092 cases or 11% of reported cases.

Comparing to the previous year's occupational injuries entitled to compensation which was 42,811 cases accounting 98% of reported injuries, while the rate of injuries was 3.5% of total employees, it showed that in 1988 the number of injuries increased by 16% while the rate of injuries was reduced by 0.9%.

Occupational Injuries by Type of Severity and Industries

In 1988 among the 49,874 cases of injuries, the Manufacturing Industry dominated the highest rate of injuries with 40,418 cases or 81%, inwhich the industry of Fabricated Metal Products, Machinery and Equipment governed the top rate of injuries with 12,377 or 25% and followed by the industry of Food, Beverage and Tobacco with 8394 or 17% and the indutry of Textiles,Wearing and Apparel with 5345 or 11% . The least is the industry of Agriculture with 155 cases or 0.3%

The rate of injuries classified the same way still keeps its pace as it was for several years as well as the Manufacturing Industry that kept its rate at top every year.

In detail the highest rate of fatalities was in the industry of Construction with 52 cases followed by the Manufacturer of Food, Beverage and Tobacco with 45 cases and the Transport, Storage and Communication Industry with 44 cases Meanwhile in 1987 the Transport, Storage and Communication Industry topped the rate of fatalities with 69 cases.

Refer to the Safe-T-Score, the Construction Industry ha kept the top rate of Frequency of Injuries most of the years.

Occupational Injuries by Type of Severity and Size of Establishment

Due to the awareness of the neccessity of the safety environment for the employees, in 1985 the government has regulated that for the establishment with more than 100 employees there must be one authorised personnel to be in charge of safety, and the Labour Department will offer the training and education of safety in the industry to that personnel periodically.

The size of 200-499 employees had topped statistic for years, in 1988 this size of establishment carried 13,275 cases of injuries and followed by the sizes of 100-199 and the 50-99 with 9,284 and 7,545 cases respectively, this arrangement in sequence has been repeated for the last three years.

In detail, the highest rate of fatalities and Permanen Partial Disability belonged to the size of 20-49 employees fo the last three years with 100 and 436; 71 and 420; 79 and 377 i 1988,1987 and 1986 respectively.

Occupational Injuries
by Type of Severity and Cause of Injuries

Because of the classification of the injuries was no sophisticatedly clarified, the class of the "Others" gained th highest cases of injuries every year, however the existin classification could give enough broad idea of the major frequen causes of injuries for the organization to manipulate it strategy to manage its individual safety awareness.

In 1988 the number of cases following the "Others" wa the Striking Against Objects; Collapse or Strike by Fallin Objects and Traffic Accidents with 9,760; 7,281 and 1,971 case respectively. The most severe cause was the Traffic Accident that attained the fatality of 175 cases while the "Others" gaine only 45 cases and followed by Electric Shock with 34 cases.

Occupational Injuries
by Type of Severity and Part of Body

It was revealed that the severe injury rendering fatality has been the Traffic Accidents for years though the government tried to convince the car drivers to utilise the seat belts and the motorcycle riders to put on helmets by publicity and promotion, there still was very few wakened.

The Part of Body injured to fatality was Multiple Injuries with 211 cases among 352 fatalities in 1988, the next one was Head and Neck with 58 cases . Such sequence has been repeated for years.

Among the 49,874 injuries, the Part of Body frequently injured was Fingers with 14,351 cases followed by Eyes; Others and Feet with 7,478; 5,067 and 4,412 cases respectively. The norm of Part of Body injured in sequence had been Fingers, Eyes and Feet.

Occupational Injuries
by Type of Severity and Age

The Labour Force Act has protected the young people unsuitable employment that the young ones under 12 years old cannot be employed for any career, it is allowed to employ the young ones above 12 up to 15 years old for jobs with the permission of the Labour Department and those between 15 to 18 will not be able to be employed for some certain jobs.

In 1988 the 20-29 year group was injured the most with 27,850 cases, followed by the 30-39 and 16-19 year group with 10,128 and 7,706 cases respectively. The sequence of such order has been repeated for most of the years.

In details every type of injuries also kept the same sequence of order. However it should be noticed that the 16-19 year group retained a very short range eg. only 4 years of age while the others retained 10 years of age , so from the bigger group of age the members in the group was certainly much more than the smaller which ofcourse gave more cases of injuries.

The younger group of the 16-29 years has been injured at most every year by the reason that they were the largest group of labour force and perceived less skill and experience while some are rash and reckless to risk in managing their jobs more than the elder groups. However it shoud be noticed that the highest rate of fatality was occured in the group of 30-39 years with 9.6% of its total injuries and followed by the 20-29 and 16-19 years with 5.2 and 4.5% of individual total injuries.

Occupational Injuries by Type of Severity and Size of Establishment

The highest injuries occured from the size of 200-499 persons with 13,275 cases and followed by the size of 100-199 an 50-99 persons with 9,284 and 7,545 cases. The highest fatalit rate occured in the size less than 20 persons with 7.9% followin by the size of 50-99 and 100-199 persons with 7.6 and 6.1 % respectively.

It should be notified that since the size less than 2 persons is not under the control of the Compensation Law, many injuries were not reported to the Labour Department so what was shown might mislead the reader.

The size that managed the best safety should be the 50-99 persons which rendered 7,545 injuries from the member of 235,985 persons or the rate of injury was 3.19% of its member while the size of 100-499 persons rendered 22,559 injuries from the member of 561,454 persons or the rate of injury was 4.02%. To confirm this conclusion, the rate of injury occured from the size 50-99 persons would be 2.18 persons per establishment of 3,446 establihments which was better than 8.12 persons per establishment of 2,778 establihments of the size 100-499 persons.

TABLE 1 OCCUPATIONAL INJURIES BY TYPE OF SERVERITY AND INDUSTRY
IN WHOLE KINGDOM, 1988

Industry	Total	Fatalities	Permanent total disability	Permanent partial disability	Temporary disability	
					over 3 days	up to 3 days
Total	49,874	352	37	1,468	21,428	26,589
Agriculture	155	10	-	14	63	68
Mining	438	21	-	12	267	138
Manufacturing	40,418	140	17	1,184	17,313	21,764
Manufacture of Food, Beverage and Tobacco	8,394	45	5	118	3,483	4,743
Textiles, Wearing Apparel	5,345	9	-	98	2,745	2,493
Wood and Wood Product Including Furniture	4,932	25	1	257	2,535	2,114
Paper and Paper Products, Printing and Publishing	953	3	-	21	389	535
Chemical, Petroleum, Coal, Rubber and Plastic Products	3,455	9	1	93	1,512	1,840
Non-Metallic Mineral Products Except Petroleum and Coal	2,303	13	-	52	874	1,364
Basic Metal Industries	2,730	8	1	45	1,262	1,414
Fabricated Metal Products, Machinery and Equipment	12,377	17	9	461	4,438	7,452
Other Manufacturing Industries	229	6	-	39	75	109
Electricity, Gas and Water	361	23	4	32	223	79
Construction	3,451	52	7	93	1,237	2,062
Wholesale and Retail Trade and Restaurants and Hotels	2,561	40	1	36	1,016	1,468
Transport, Storage and Communication	1,212	44	5	45	719	399
Services	1,278	22	3	52	590	611

Source : Labour Studies and Planning Division, Department of Labour

TABLE 2 OCCUPATIONAL INJURIES BY TYPE OF SERVERITY AND INDUSTRY
IN WHOLE KINGDOM, 1987

Industry	Total	Fatalities	Permanent total disability	Permanent partial disability	Temporary disability over 3 days	Temporary disability up to 3 days
Total	42.811	315	19	1,158	18,182	23,146
Agriculture	-	-	-	-	-	-
Mining	401	12	-	5	253	131
Manufacturing	35,055	124	1	981	14,753	19,196
Manufacture of Food, Beverage and Tobacco	7,733	46	-	138	3,158	4,391
Textiles, Wearing Apparel	4.633	14	-	58	2.386	2,175
Wood and Wood Product Including Furniture	4,174	17	-	145	2,063	1,944
Paper and Paper Products, Printing and Publishing	848	4	-	20	387	437
Chemical, Petroleum, Coal, Rubber and Plastic Products	3,188	7	-	94	1,369	1,718
Non-Metallic Mineral Products Except Petroleum and Coal	1,871	7	1	45	779	1,039
Basic Metal Industries	2,686	9	-	40	1,019	1,618
Fabricated Metal Products, Machinery and Equipment	9,745	20	-	438	3,542	5,745
Other Manufacturing Industries	182	-	-	3	50	129
Electricity, Gas and Water	31	-	-	-	10	21
Construction	2,736	35	3	68	983	1,647
Wholesale and Retail Trade and Restaurants and Hotels	2,355	42	3	47	996	1,267
Transport, Storage and Communication	998	57	-	34	639	268
Services	1,235	45	3	23	548	616

Source : Labour Studies and Planning Division, Department of Labour

TABLE 3 OCCUPATIONAL INJURIES BY TYPE OF SERVERITY AND INDUSTRY
IN WHOLE KINGDOM, 1986

Industry	Total	Fatalities	Permanent total disability	Permanent partial disability	Temporary disability over 3 days	Temporary disability up to 3 days
Total	38,410	363	36	1,206	17,066	19,739
Agriculture	29	7	2	8	12	0
Mining	605	13	0	11	293	294
Manufacturing	30,345	121	18	913	13,258	15,735
Manufacture of Food, Beverage and Tobacco	6,523	43	1	83	2,804	3,592
Textiles, Wearing Apparel	4,197	12	0	99	2,325	1,761
Wood and Wood Product Including Furniture	3,535	22	2	139	1,704	1,668
Paper and Paper Products, Printing and Publishing	767	6	1	28	341	391
Chemical, Petroleum, Coal, Rubber and Plastic Products	2,544	5	0	111	1,097	1,331
Non-Metallic Mineral Products Except Petroleum and Coal	1,960	13	1	35	878	1,033
Basic Metal Industries	2,322	2	5	53	1,018	1,244
Fabricated Metal Products, Machinery and Equipment	8,124	17	3	331	3,213	4,560
Other Manufacturing Industries	168	1	5	29	78	55
Electricity, Gas and Water	367	16	2	30	225	94
Construction	2,889	56	4	88	1,163	1,578
Wholesale and Retail Trade and Restaurants and Hotels	2,297	46	2	66	1,013	1,170
Transport, Storage and Communication	1,083	59	4	57	612	351
Services	1,095	48	4	33	493	517

Source : Labour Studies and Planning Division, Department of Labour

TABLE 4 OCCUPATIONAL INJURIES BY TYPE OF SERVERITY AND INDUSTRY IN WHOLE KINGDOM, 1988

Bodily Location of the Injuries	Total	Fatalities	Permanent total disability	Permanent partial disability	Temporary disability over 3 days	Temporary disability up to 3 days
Total	49,374	352	37	1,468	21,428	26,539
Head	1,533	53	1	13	564	901
Eyes	7,478	-	-	25	1,103	6,347
Nose	171	-	-	1	55	115
Ears	140	-	-	-	33	107
Face. Check,Eyebrow, Chin, Jaw	1,191	3	-	7	353	828
Shoulder, Armpit	473	-	-	3	231	239
Arms	2,707	-	1	33	1,081	1,592
Hands	3,438	3	1	79	1,552	1,803
Fingers	14,351	1	14	1,120	7,536	5,680
Trunk	87	-	-	1	32	54
Back	1,487	-	2	5	595	885
Legs	1,906	1	3	28	968	906
Feet	4,412	1	-	25	2,021	2,365
Toes	2,527	4	-	45	1,296	1,182
Multipl Injuries	2,900	211	6	42	1,616	1,025
Others	5,067	70	9	36	2,392	2.560

Source : Labour Studies and Planning Division, Department of Labour

TABLE 5 OCCUPATIONAL INJURIES BY TYPE OF SERVERITY AND INDUSTRY IN WHOLE KINGDOM, 1987

Bodily Location of the Injuries	Total	Fatalities	Permanent total disability	Permanent partial disability	Temporary disability	
					over 3 days	up to 3 days
Total	42,811	315	10	1,158	18,182	23,146
Head	1,506	53	2	4	543	904
Eyes	5,998	-	-	28	868	5,102
Ears	113	1	-	2	22	88
Face, Check,Eyebrow, Chin, Jaw	1,177	1	-	-	385	791
Shoulder,Armpit	429	-	-	1	208	220
Arms	2,226	-	-	20	911	1,295
Hands	3,833	1	-	80	1,721	2,031
Fingers	12,285	-	-	917	6,325	5,043
Trunk	930	17	-	1	333	579
Back	1,512	-	4	13	632	863
Legs	2,183	1	1	14	1,094	1,073
Feet	4,686	-	-	17	2,204	2,465
Toes	2,158	1	-	33	1,066	1,058
Multipl Injuries	2,460	223	2	22	1,323	890
Others	1,315	17	1	6	547	744

Source : Labour Studies and Planning Division, Department of Labour

TABLE 6 OCCUPATIONAL INJURIES BY TYPE OF SERVERITY AND INDUSTRY IN WHOLE KINGDOM, 1986

Bodily Location of the Injuries	Total	Fatalities	Permanent total disability	Permanent partial disability	Temporary disability	
					over 3 days	up to 3 days
Total	37,445	285	10	978	16,581	19,591
Eyes	5,312	-	-	30	818	4,464
Ears	228	-	-	-	37	191
Head	1,522	57	2	6	526	931
Face, Check, Eyebrow, Chin, Jaw	1,082	1	-	-	366	715
Hands	3,396	3	-	87	1,643	1,663
Fingers	9,576	-	-	715	5,228	3,633
Arms	1,849	-	1	16	785	1,047
Trunk	976	20	-	-	351	605
Back	1,336	2	2	4	596	732
Shoulder, Armpit	417	-	-	2	199	216
Feet	4,524	-	-	33	2,174	2,317
Toes	1,802	-	-	29	964	809
Legs	1,947	-	1	24	982	940
Multipl Injuries	2,446	186	3	29	1,389	839
Others	1,032	16	1	3	523	489

Source : Labour Studies and Planning Division, Department of Labour

TABLE 7 OCCUPATIONAL INJURIES BY TYPE OF OCCUPATIONAL INJURIES AND
TYPE OF SERVERITY IN WHOLE KINGDOM, 1988

Type of Occupational Injuries	Total	Fatalities	Permanent total disability	Permanent partial disability	Temporary disability	
					over 3 days	up to 3 days
Total	49,874	352	37	1,468	21,428	26,589
Falls of persons from heights	1,495	40	4	25	901	525
Falls of person on the same level	1,237	1	-	9	598	629
Collapse or strick by falling objects	7,281	26	5	209	3,868	3,173
Striking againt objects	9,760	15	11	512	4,759	4,463
Over exertion or strenuous movement	1,590	2	1	5	603	979
Traffic accidents	1,971	175	5	54	1,259	478
Explosion	245	6	-	5	134	100
Electric Shock	452	34	4	15	231	168
Touching with hot substances or object	1,299	2	-	4	721	572
Touching with hazadeus substances	1,913	2	-	3	344	1,564
Noise	9	-	-	-	1	8
Danger by men	79	3	1	2	52	21
Cocerning Occupation Diseases	38	1	-	1	25	11
Others	22,505	45	6	624	7,932	13,898

Source : Labour Studies and Planning Division, Department of Labour

TABLE 8 OCCUPATIONAL INJURIES BY TYPE OF OCCUPATIONAL INJURIES AND TYPE OF SERVERITY IN WHOLE KINGDOM, 1987

Type of Occupational Injuries	Total	Fatalities	Permanent total disability	Permanent partial disability	Temporary disability	
					over 3 days	up to 3 days
Total	42,811	315	10	1,158	18,182	23,146
Falls of person from heights	1,273	34	1	8	801	429
Falls of person on the same level	1,109	4	1	4	561	539
Collapse or strick by falling objects	4,807	16	4	96	2,446	2,245
Striking againt objects	6,466	8	1	102	2,752	3,603
Over exertion or strenuous movement	1,810	2	-	14	666	1,128
Traffic accidents	2,001	165	3	39	1,237	557
Explosion	277	10	-	5	151	111
Electric Shock	382	31	-	2	205	144
Touching with hot substances or object	1,317	9	-	5	704	599
Touching with hazadeus substances	1,845	-	-	-	387	1,458
Noise	9	-	-	2	1	6
Danger by men	199	9	-	-	117	73
Cocerning Occupation Diseases	280	-	-	-	30	250
Others	6,374	11	-	63	2,109	4,191

Source : Labour Studies and Planning Division, Department of Labour

TABLE 9 OCCUPATIONAL INJURIES BY TYPE OF OCCUPATIONAL INJURIES AND
TYPE OF SERVERITY IN WHOLE KINGDOM, 1986

Type of Occupational Injuries	Total	Fatalities	Permanent total disability	Permanent partial disability	Temporary disability	
					over 3 days	up to 3 days
Total	37,445	285	10	978	16,581	19,591
Falls of person from heights	1,261	39	1	13	778	430
Falls of person on the same level	1,094	4	-	3	533	554
Collapse or strick by falling objects	4,635	19	1	92	2,464	2,059
Striking agaist objects	6,207	9	1	116	2,809	3,272
Over exertion or strenuous movement	1,695	-	-	6	632	1,057
Traffic accidents	2,118	136	5	44	1,369	564
Explosion	302	4	-	3	124	171
Electric Shock	380	23	-	7	193	157
Touching with hot substances or object	1,169	4	-	3	623	539
Touching with hazadeus substances	1,549	1	-	1	329	1,218
Noise	121	-	-	-	10	111
Danger by men	81	18	-	2	50	11
Cocerning Occupation Diseases	265	4	-	-	55	206
Others	4,965	12	-	41	1,863	3,049

Source : Labour Studies and Planning Division, Department of Labour

TABLE 10 OCCUPATIONAL INJURIES BY TYPE OF SERVERITY AND INDUSTRY IN WHOLE KINGDOM, 1988

Size of Establishment	Total	Fatalities	Permanent total disability	Permanent partial disability	Temporary disability over 3 days	Temporary disability up to 3 days
Total	49,874	352	37	1,468	21,428	26,589
Less than 20 persons	330	26	21	177	87	19
20-49	6,162	103	5	436	2,947	2,674
50-99	7,565	57	1	263	3,192	4,032
100-199	9,284	57	2	167	3,762	5,296
200-499	13275	42	1	187	5,384	7,661
500-999	6,280	30	2	72	2,713	3,463
1,000 and over	6,998	40	5	166	3,343	3,444

Source : Labour Studies and Planning Division, Department of Labour

TABLE 11 OCCUPATIONAL INJURIES BY TYPE OF SERVERITY AND INDUSTRY IN WHOLE KINGDOM, 1987

Size of Establishment	Total	Fatalities	Permanent total disability	Permanent partial disability	Temporary disability over 3 days	Temporary disability up to 3 days
Total	42,811	315	10	1,158	18,182	23,146
20-49	5,488	71	2	420	2,571	2,424
50-99	7,049	62	-	190	2,889	3,908
100-199	9,186	64	4	177	3,500	5,441
200-499	10450	60	2	199	4,286	5,903
500-999	5,327	27	1	77	2,497	2,725
1,000 and over	5,311	31	1	95	2,439	2,745

Source : Labour Studies and Planning Division, Department of Labour

TABLE 12 OCCUPATIONAL INJURIES BY TYPE OF SERVERITY AND INDUSTRY IN WHOLE KINGDOM, 1986

Size of Establishment	Total	Fatalities	Permanent total disability	Permanent partial disability	Temporary disability over 3 days	Temporary disability up to 3 days
Total	37,445	285	10	978	16,581	19,591
20-49	4,799	71	3	361	2,330	2,034
50-99	5,758	64	3	189	2,586	2,918
100-199	7,811	48	2	139	3,079	4,543
200-499	9,383	49	1	146	3,964	5,223
500-999	4,979	18	-	89	2,096	2,780
1,000 and over	4,715	35	1	58	2,528	2,093

Source : Labour Studies and Planning Division, Department of Labour

PERSONAL SAFETY EQUIPMENT MARKET AND OPPORTUNITY

Product : 1. Most of the product or about 90% are imported. Th import from USA dominates the market, the left ar from Australia,Sweden,France,Singapore,Netherlands and Japan, etc.

2. Some are produced locally such as helmets, gloves shoes.

3. Product types in Thai market are as follows:

   - Respirator protection
   - Face protection
   - Hand protection
   - Eye protection
   - Ear protection

Price : 1. Leader pricing is applied. The leader company controls nearly every product's price.

2. Discount in this industry is 10% from list price.

Place : 1. The manufacturers besides conduct direct sales, th distributors are also their outlets and some distributors are agents of various imports.

2. The agents also distribute their import products t several subagents for end consumers.

3. Channel distribution :

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              --------------                          ------------
              | Manufacturer |--------------------> | Consumer   |
Local   :     --------------                          ------------
products     .--------------.      .------------       ----------
              | Manufacturer |----->|Distributors|--->| Consumer |
              --------------        ------------       ----------


              --------------                          ------------
              |    Agent     |--------------------> | Consumer   |
Imported :    --------------                          ------------
products      --------------        ------------       ----------
              |    Agent     |----->|Distributors|--->| Consumer |
              --------------        ------------       ----------
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Promotion : 1. Direct mail to the end users who are factories with 100 employees or more , especially off-shore owned or shared factories.
2. Exhibitions
3. Cooperation with government organizations in training courses for industrial safety
4. Publicity

Production : 1. Products without high technology are produced locally because the investment is not so high.
2. Small market size is not suitable for hi-tech product production.
3. Manufacturers are likely to be family business

4. Local products are used in domestic market and neighbour countries.

Market : Situation

1. The market of Personal Safety Equipment is likely to emphasize the industrial users.
2. The small scale to medium scale industries are not aware of the personal safety like the big scale industry because it means a significant amount of expense and investment
3. Since the labour forces of domestic owned factories are not accustomed to the safety devices application they like to take the devices off or neglect to use without awareness of their own safety, it results that the executive has to pick up devices and decrease the budget.
4. Off-shore owned or shared factories pay higher and stronger attention to personal safety. The budget is set up with safety awareness and safety rules are strictly practised.
5. Government's reputation on personal safety is not so strong that many factories still neglect the application of safety devices. The goverment body will intervene after hazard accident occurs.

Opportunity :

1. Thai industry is growing very fast, many large scale factories by offshore investors are established so the personal safety devices ofcourse obtain a prospect market.
2. Canadian investors should find out a vacuum line of hi-tech personal safety products aiming at the domestic market while Asean will be another target.
3. Manufacturing of hi-tech personal safety products can take advantage of cheap `labour forces with support from the Board of Investment for many special previleges.

THE 7TH. NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT PLAN

So far the draft of the 7th. NESDP ruling the year 1992-1996 is on the process, the following presentation of the 7th.NESDP will be a noncommitted guidelines for the plan drafting. Only the section of the Environmental planning is summarised as follows:

1.The Environmental Development Policy

1.1 Investment on protection and solving the environmental problems affecting the major national resources and quality of life should be encouraged.

1.2 Educating the public to understand and to participate in developing, protecting and solving the environmental problem.

1.3 Promote the private sector to participate the government's operation

1.4 Promote the mechanism of cooperation between the local and the regional execution to cope with the conditions and constraints of individual situations.

1.5 Encourage all participants to reduce the waste releasing and to circulate the waste for another useful extent by incentives.

1.6 Amend laws and regulations concerning the pollution to comply with the appropriate situations.

1.7 Promote the study and research of environmental problems including the data base compilation for the use of technological development and environment planning apposite to the controlling and solving environmental problems.

1.8 Concentrate on the implementation.

2. Strategies and Guidelines

2.1 Strategy 1: Control, protect and solve the water pollution

Guidelines :

:: Protect and solve the water pollution in main rivers and coasts

- Inhibit establishing new factories that tend to create pollution along the river sides and coastal area
- follow up the distortion of the water quality in the inland water resources eg. rivers, reservoirs, etc.

:: Control the waste water sources eg. community, industries, agriculture, etc, not to discharge waste directly to the water resources

- invest on central waste treatment system
- encourage the grouping of industries in a certain area and plan the waste control system from the beginning
- inhibit the releasing of disposal and nightsoil through the watersheds
- encourage the farmers to retain various farm waste for producing byproducts eg. organic fertilizer, algae farm, etc.
- strictly control the factories' waste discharge

:: Promote the research and application of the technologies that do not initiate wastes

- motivate the private sector with incentives to join ventures with the government organizations for the central waste treatment system
- reimburse the cost of the waste treatment and management from the waste producers
- publicity to call for society and community cooperation on pollution awareness

2.2 Strategy 2 : Control, protect and solve air and noise pollution from the automobiles, factories and transportation

Guidelines :

:: Budget, manpower and equipments will be supplied to the working groups. Appropriate measures and regulations will be issued to cope with the situations in each major city inwhich specified areas collaborated with responsible working groups are clarified.

:: Measures and guidelines to control air and noise pollution from various sources will be clarified

:: Publicity to call for people's awareness

:: Promote and encourage the consumption of the fuel that creates less toxic and polluted fume to the community while controlling the pollution by government organizations with performance

:: Encourage to find efficient application of the thermal energy and issue measures to protect and solve the Greenhouse Effect

2.3 Strategy 3 : Control, protect and solve the solid wastes.

Guidelines :

:: Appropriate measures and guidelines of systemmatic disposition of solid waste accounting the detaining, collecting, transporting, completely decomposing including reusing will be promoted

:: Reuse of the disposal, refuse and nightsoil will be promoted in order to save resources and to reduce cost of disposing and to solve the pollution problem

:: Infective disposals from hospitals are to be controlled and disposed correctly

:: Publicity and training in disposing the wastes correctly to the government and private sectors including laymen will be provided

:: Amend the appropriate measures and regulations on waste disposing to facilitate the practical implementations that confidently pave the way to prevention and solving future problems

2.4 Strategy 4 : Control, protect and solve the toxic substances problems

Guidelines :

:: Integrated management to control toxic substances accounting import, warehousing, transporting, production, removing, distribution, application including disposing the wastes will be carried out

:: Chemicals for agriculture business that tends to create pollution will be strictly limited to an extent and substituted by integrated pest management

:: Publicity of toxic materials will be promoted in order to lessen the danger of consumption of contaminated substances

:: Prevention measures and regulations issued will be practical. The chemical producers have to report the effect of their production upon the environment

:: Specific location and standard of warehouse for chemicals will be carried out in order to protect the community from chemical hazard and to render safety to habitants

2.5 Strategy 5 : Control, protect and solve the pollution problems in macro level

Guidelines :

- :: Master plan descends to implementation of pollution control will be executed integratedly in the specified areas of high potential of economic growth in order to control the pollution effectively
- :: set up the follow up system and data base for controlling and future planning
- :: Develop and promote the steering organizations nation wide to cooperate all bodies to meet the government objectives with performance
- :: Stimulate the development of technologies that can solve the pollution problems efficiently

REDUCTION OF THE IMPORT DUTY ON THE MACHINERY,MATERIAL AND EQUIPMENT THAT SAVE ENERGY AND CONSERVE ENVIRONMENT

The 5th. NESDP (1982-1986) has emphasized on the saving of energy in the industry segment and protection of the pollution by the industry segment. On the August 17,1982 the government has issued a measure to promote the said emphasis that a reduction of import duty on the machinery, material and equipment that are able to save energy and conserve environment will be offered under the following conditions :

1. A board to implement this measure is consisted of the representatives from the government and private sectors. The board will determine whether which of the machinery, material and equipment proposed can be adopted under this measure and the Customs Department will be notified later by the board

2. Reduced rate will be either text 1.1 or text 1.2 that

   yeilds the lower amount
   1.1 One half of the normal duty rate
   1.2 In case of the rate is higher than 10%, the reduced rate will be 10%

3. The machinery, material and equipment that save energy will perform the following functions :
   3.1 It can convert the waste or the lost energy to applicable energy

- 3.2 It can substitute the electric power or petroleum fuel
- 3.3 It can boost or replace the existing machinery or system to save energy

The said machinery, material and equipment should give the break even point in 2-7 years since applied

4. The machinery, material and equipment that conserve environment will perform the following functions:
   - 4.1 It can treat polluted water
   - 4.2 It can treat polluted air
   - 4.3 It can dispose solid wastes, refuse
   - 4.4 It can reduce or protect the disturbing noise from sources in industry
   - 4.5 It is used in research, analysis, measurement and follow up in conservation of environment

The said machinery, material and equipment in the text 4.1 and 4.2 will :

1. be specifically used for the energy and environmental conservation
2. be fitted to the building, factory, hospital or hotel with above 80 rooms and with the cost in CIF above Baht 400,000
3. not be used before hand or rebuilt
4. not be the same size or capacity or type or subsitutable to those manufactured locally
5. not be the types inhibited to adopted under this measure by the Customs Department

5. Application will be processed by the applicants who possess the following qualifications :
   - 5.1 Importers of machinery, material and equipment that conserve energy and environment for their own use

5.2 If the end users purchase through the importers, agents or any middlemen, the contracts of procurement and installation on the site of the end users have to be clarified

In case of the application fails the applicant can present an appeal in 15 days after rejection.

6. Service center is set up at the Center of Technlolgy Transfer, 6th. floor or at the Private Sector Service Center, 1st. floor, in the Office of the Ministry Secretary, Ministry of Science Technology and Energy, Rama 6 Road, Phyathai, Bangkok 10400, tel: 245-0746, 246-0064 ext.33

IMPORT STATISTIC 1988 - 1989

Some Environmental and Safety Protection Products

Value : Baht 1,000

Items	1988	1989 (Jan. - Oct.)
Life jackets and life belts	3,577	2,001
Metal toe cap footwear	129	280
Protective metal toe cap	1,438	1,747
Safety Headgear	11,539	13,414
Head-bands for headgear	96	251
Safety glasses	12,448	21,222
Rear view mirrors for vehicles	9,291	5,795
Safes, Strongbox	33,877	32,522
Centrifuges	316,565	443,758
Centrifuges for purifying water	220,332	165,432
Oil filters	43,454	62,714
Purifying machinery for gas	150,085	131,233
Intake air filters for engine	23,324	20,053
Other purifiers	159,863	232,499
Parts of centrifuges	16,786	33,125
Other centrifuges	328,920	308,683
Fire extinguisher	53,870	63,254
Burglar or fire alarm	34,046	54,801
Automatic circuit breaker	35,573	38,485
Delighting arresters	65,578	58,454
Fire boats	562,333	3,838
Other vessels including warship & lifeboats	2,055	1,914
Protective glasses	11,824	12,667
Gas masks, artificial respiration apparatus	20,214	21,291

THE BANGKOK METROPOLIS WASTE PROJECT
DURING 1992-1996

1. **PROJECT :** **Subcontract the collection to private company**
PLANNING: Location : Districts of Bangkoknoi, Subdistricts of Klongtoey, Klongton
: Contract lasted through November 1989
: Bidding for new contract
BUDGET :
OPERATION : Inspectors had been provided to investigate the jobs done and found that some responsibility could not be handled by private sector

2. **PROJECT :** **Two collection stations**
PLANNING:: Location 1 : Huaykwang or Bangkapi District
: Covering districts of Huaykwang, Patumwan, Payāthai
: Collection capacity of 625 tons per day
: Land fill disposal at site
: Private company investment on land and buildings
:: Location 2 : Ramaindra
: Covering Districts of Bangkapi, Sampantawong, Pomprab and neighbours
: Collection capacity 500 tons a day
: Land fill disposal at BMA's site
: BMA investment and subcontract the collection
BUDGET : not allocated
OPERATION : no operation

3. PROJECT : Two garbage truck centers
PLANNING:: Location 1 : Onnoot Plant
: Trucks parking lot for districts of Huaykwang, Patumwan, Payathai, Dusit, Prakanong and Bangkapi
: Construction of buildings and Gas station, maintenance and repair service
: Scheduled in 1990 with budget of Baht 31,700,000
:: Location 2 : Nongkam Plant
: Serve trucks from districts of Pomprab, Sampantawong, Yannawa and all Thonburi
: Construction of same facilities for 220 trucks
: Scheduled in 1991
OPERATION : not yet implemented

4. PROJECT : Infectious Waste Disposal
PLANNING: Construction of new plant and incinerator
: Located at Onnoot Plant
: Capacity of 40 tons per day
: Red disposal plastic bag is distributed to identify the infectious waste
: Scheduled in 1989-1991
OPERATION : no report

5. **PROJECT :** Sanitary landfill disposal
PLANNING:: Location 1 : Onnoot Plant
Capacity : 2 million cubic meters plus of existing out-dumping disposal
: Sanitary 10 meter depth landfill
:: Location 2 : Nongkam Plant
:: Location 3 : Ramaindra Plant
: Total capacity 1,510 tons per day
BUDGET : Total budget Baht 1,248.8 million
OPERATION : no fiscal budget allocated

6. **PROJECT :** Four city-rim incinerators
PLANNING: Location at districts of Yannawa and Dusit are determined
: Capacity 1500 tons per day each
BUDGET : Baht 2,000 million including land, each
OPERATION : Infeasibly implemented, by the high rise of land cost and scarcity of land.
: Updating feasiblity study is undertaken

7. **PROJECT :** Composting Plant
PLANNING: Location at districts of Bangkuntien and Talingchan are determined
: Capacity : 260 and 540 tons per day resp.
: Schedule : year 1995-1998 and 1997-2000 resp.
BUDGET : Baht 251.6 and 453.6 million resp.
OPERATION : To cope with the excess amount of garbage, BMA has built a Composting Plant at Onnoot Plant with 1000 tons per day capacity, scheduling in 1989

BANGKOK SEWERAGE SYSTEM PROJECTS

1. RATANAKOSIN PROJECT
2. YANNAWA DISTRICT SEWERAGE SYSTEM CONSTRUCTION PROJECT
3. PROJECT : THE STUDY OF THE SYSTEMATIC OPERATION FOR THE IMPROVEMENT OF WATER QUALITY IN CANALS IN BANGKOK
4. PROJECT : WATER TREATMENT AT AREA 2A
5. PROJECT : WATER TREATMENT IN SIPRAYA AREA
6. STUDY AND FIND OUT DETAILS OF THE SUBZONE PLANTS
7. PROJECT : THE STUDY FOR DESIGNING THE TREATMENT PLANTS ON THONBURI AREA

RATANAKOSIN PROJECT

Bangkok Sewerage System Project

October 1988
Policy and Planning Department
Bangkok Metropolitan Administration

Ratanakosin Project

1.Background

The purposes of this project are restoration and development of Canals along the historic profile of the original quarter of the city, Ratanakosin area. The first design was initiated by a group of engineering consultants, namely, Asian Engineering Consultant (AEC) , Sumeth Chumsai Architech Co. and MH Planning and Development Co.Ltd. The consortium was employed to study the construction of dykes, sewage interceptors and a domestic sewage treatment plant. The study was submitted to Department of Drainage and Sewerage in September 1982.(Fig 1)

The Department of Drainage and Sewerage was responsible for the project had planned to restore the embankment along the original Canals. The restoration was meant to be completed before the Ratanakosin bicentenial celebration. In 1984; A budget of 104 million Baht was granted by the city council to be used for construction of dykes along Klong Lord North and interceptors along both North and South Klong Lord.

However, a change in the city council caused the project to be restudied. The later study turned out to be in agreement with the initial one. Nevertheless, difficulty in maintenance of interceptors was concerned. The present council, lead by Major General Chamlong Srimuang, suggested that the embankment should not be casted together with the sewage interceptors to avoid the risks of damage due to future subsidence. The council appointed a Technical committee chaired by Mr.Anuchit Sodsathit to review the sewerage system. This committee comprises of representatives from several organisations, Such as, Environmental Research Institute of Chulalongkorn University, ONEB, Dept.of Civil, Mahidol University.

The technical committee proposed to build interceptors on both sides of Klong Lord as separate structures from the embankment and increase the collection capacity to 25,000 cum/d instead of the original 19,000 cum/d.

2.Treatment Plant

To prevent deterioration of the 3 klongs in the Ratanakosin area, the construction of domestic sewage treatment plant along with the collecting system was proposed.

2.1 Information

-Project Area 3.09 sq.km
-Population 74,000 persons
-Population density varies from 5,587 pop/sq.km
to 52,688 pop/sq.km
During daytime the number
of10,800 pop/day is added
through works and tourist.

-Effluent Rate

Resident	190 litre/day-pop
Commercial building	9,300 m3/day-sq.km
Institution	4,000 m3/day-sq.km
Seepage	760 m3/day-sq.km

-Rain in the 2 years recurrent	60 mm/hr.
-Run-off Coefficient	0.5

2.2 Designs Criteria

The plant was to be located at Ban Phan Thom with initial design as

-Waste treatment capacity 25,000 m3/day

-Waste Characteristics

Influent	BOD	130 mg/l
	SS	100 mg/l
Effluent	BOD	20 mg/l
	SS	31 mg/l

-Process Biological Treatment

The construction was set in 1986 at Baht 60 million on the 6,400 sqm. area.

3.Policy on Privatisation

The Deputy Governor (Lt.Hansa Kaewbandit) ordered Department of Policy and Planning to look into a privatisation plan for the construction of the plant with the particular issues on.

3.1 whether the construction of the treatment plant can be carried out together with commercial buildings.

3.2 whether private company can fully or partly invest and operate the sewage work.

3.3 whether the construction of the BMA office together with a treatment plant as in 3.1 is benefitial.

A committee was authorised by the Department of Policy and Planning comprises of

Director General of Drainage and Sewerage Department

Director General of Public Works Department

Director of the BMA Marketing Office

Director of City Planning Division

Director General of Policy and Planning Department

Considerations of the Committee

1)To build the waste water treatment plant in the referred area, it is necessary to expropriate private land from the private sectors. Therefore, Department of Drainage and Sewerage has to proceed to the stage of land expropriation for 14 units of the commercial buildings, following the the approval of the committee on building the waste water treatment plant.

2) For consideration about building other buildings in the waste water treatment system, it is the responsibility of Department of Drainage and Sewerage,Policy and Planning Division1 wider Department of Policy and Planning and the BMA Marketing Office to cooperate in seeking private sectors for its investment and propose all information.

In March 1986, Seatect Co. proposed that the construction of commercial building, office and parking area on the proposed treatment plant would be feasible according to the Building Regulations. The cost was estimated at Baht 100 million with 12% interest rate on 20 years of project life. The sixth floor building has 5,150-6,560 sqm. of commercial area and 2,738 sqm. for parking. Part of the area could be rented to provide the revenue to run the sewage work. The building is capable of holding 450 residents. (Fig 4)

From the proposal, Seatect co. Concluded that the project is technically and financially feasible if the building could be rented to a certain public agency such as the Department of Drainage and Sewerage which is presently renting a private office. However, the detail study of a financial scheme could not be made available.

In March 1988, representatives from JV Taiyo-Envirtech, Nishimutsu Construction Co., lead by Mr. Kenji Shiina, Mr.Ti Hiradata, visited Deputy Governor (Mr. Wicha Jiwalai) and were briefed on the project policy as

1. The use on the building should be for

    1.1 domestic wasted treatment as mentioned in the Ratanakosin project

    1.2 commercial use is not specified but has to give high benefit to BMA with in short period.

2. As for private management, those who intend to participate in the project must notify and present the Terms of Reference.

    2.1 The project proposal must include
        2.1.1 Type of Treatment Process
        2.1.2 The project life which after expired must be turn over to the BMA.
        2.1.3 All requirements by law.

    2.2 The proposal also must include
        2.2.1 benefit which BMA will receive during the project life.
        2.2.2 Comittment on 2.1

4.Present Development

4.1 Compensation

The area, Ban Phan Thom, is 6,400 sqm.. Area is presently occupied by market and commercial buildings. Of all the 84 buildings, 13 is private owned while the rest are owned by BMA.The 13 buildings, cover 608 sqm. is now under negotiation between owners and the committe which was set up for the specific matter. (Fig 6)

The owners could not, then, agree with the compensation rate and both parties agreed to wait for the new official list price of land value before further negotiation would contiune.

A recent price-list is now available as follow
List of the Estimated rate of The Land

unit	area	price B/Wah2*
	Zone/Block 02	
1.	from Thanon Samsen about 20m.	80,000
2.	from Soi Vorapong about 20m.	50,000
3.	from Soi Phra Sawad about 20m.	50,000
4.	from Soi (1) about 20m.	45,000
5.	from Soi Ban Phan Thom about 20m.	35,000
6.	from other Sois about 20m.	25,000
7.	The left part (1-6)	15,000

*wah = 2 Meter

The new negotiation will be proceeded by September,1988

4.2 Privatisation Plan

The Bangkok Metropolitan Administration may, retain the authority and the responsibility to collect revenue or charges to cover the long-range costs of the sewerage facility while a private body may take the burden of financing, construction and operation of the system according to a contract agreement with the BMA.

USTDP Assistant

The feasibility study of the Privatizing Wastewater Treatment Project will need a Management Consultant study on financing, administration and regulation which are very important to the project implementation.

The United States has the first hand experience on sewerage privatization. There is at least one American management consultant specialising in this matter. Therefore, The BMA would like to ask for a Grant-Aid assistant form the USTDP to employ a US. cousultant to study the Financial feasibility of a private US - Thai Investor group financing, designing building, owning and operating for BMA.

YANNAWA DISTRICT SEWERAGE SYSTEM CONSTRUCTION PROJECT

DEPARTMENT OF DRAINAGE AND SEWERAGE

Project title: The Survey and Study Project for Designing a Sewerage System in the Area of Yannawa District

Agency in charge: The Waste Water Treatment Plant Division Department of Drainage and Sewerage

Fiscal year: 1989-1990

1.Concept and Justification:

Background: So far Bangkok Metropolis does not yet have a complete and hygienically central sewerage system, water used by the people which in somewhere includes water from night soil, the state of which is polluted water, would flow into rainwater drainpipes or empty places in nearby areas and trenches, canals then to the Chao Phraya River. As a result, the various trenches and canals in the area of Bangkok Metropolis are in the state of pollution as seen today. The Bangkok Metropolitan Administration initiated a solution with cooperation from Japanese government through JICA to prepare a master plan for sewerage disposal in important areas approximately 370 square kilometers, which was completed in 1983. The projected area was divided into 10 sewerage zones but the master plan was not seriously implemented due to the wan action, as well as a lack of budget and because there was no available location to construct a waste water treatment site according to the master plan, resulting in failure to start action to solve the problem of water pollution .

Problems :

Presently, water pollution in trenches and canals of Bangkok Metropolis has significantly intensified and extended to the Chao Phraya River, on which a study of the Thailand Development Research Institute (TDRI), concluded and submitted in July 1988, reported that unless action to solve the problem of water pollution in the area of Bangkok Metropolis was seriously taken, in 12 years ahead, water in the down stream of the Chao Phraya River would be polluted just like the current state of water in the trenches and canals of Bangkok Metropolis. Regarding the problem of grave concern resulting from water pollution in Bangkok Metropolis today, all the agencies involved are all wakened to learn this serious incident and to be ready for a call on strong and genuine cooperation.

Solution :

An effective solution to the problem of water pollution in Bangkok Metropolis requires both preventive and solving measures. Preventive measures include the application of legal actions or public relations to educate people in releasing waste water, while solving measures may be taken in the form of constructing sewerage systems in which waste water is treated to meet a standard before being released further into the trenches and canals.

A long-term effective solution to the problem of water pollution in Bangkok Metropolis requires that sewerage systems must be constructed throughout the area of Bangkok Metropolis according to the proposed master plan from JICA. A few sewerage zones feasible to the construction of waste water treatment plants will be implemented in the first stage

For the time being, in the area of Yannawa, Zone 3 under the master plan of JICA, the Bangkok Metropolitan Administration has already expropriated an area of approximately 20 rai of land in the vicinity of the mouth of Chong Nongsee canal and has designated it as the construction site of the waste water treatment plant of this zone. In addition, as this area is developing very quick and surrounded by the Chao Phraya River in larger part than any other zones, waste water in this zone can run into the Chao Phraya River very easy and fast. Therefore, Bangkok Metropolitan Administration has to construct the sewerage system of the Yannawa zone urgently as to mark the beginning of preventive measures against water pollution in

Bangkok Metropolis.

2. Objectives:

To carry out a survey, a study and the design of a sewerage system in the area of Yannawa District covering a space of 25 square kilometers and prepared for treating waste water released by the population to be residents of the area in the year 2010 and to construct the sewerage system as part of the effort to solve the problem of water pollution of Bangkok Metropolis.

3.Targets:

A consultant engineering company with experiences in this field will be employed to carry out the survey and the study with a view to prepare the drawings and specifications of various constructions of the sewerage system in the area of Yannawa District, with targets as follows:

1. To carry out the survey of the whole area of 25 square kilometers in order to determine the number of sub-zones of the sewerage system in the area of Yannawa District by taking into consideration the feasible waste water treatment plant construction site as the basis to reduce the quantity of waste water of the whole area of Yannawa District (Zone 3) that will have to be treated at the mouth of Chong Nonsee Canal according the original JICA master plan.

2. To carry out the survey and the study of the details of the construction of the sewerage system for only the areas of the sewerage zone from which waste water will have to be taken to be treated in the area of the mouth of Chong Nonsee Canal, consisting of:

2.1 A collection system that must be consistent with original good conditioned drainpipes.
2.2 A sewerage system that must be suitable for the size of the area approximately 20 rai.

3. Schedule : through the completion of designing will be about one year and six months beginning in Fiscal year 1990.

4. The Character of the Project:

This project is to survey and study the determining measures to solve the problem of environmental degeneration with respect to water pollution in the area of Bangkok Metropolis. This project relates with projects for solving the problem of environmental degeneration in other areas of Bangkok Metropolis.

This project is prevailed in the 3rd Bangkok Metropolis Development plan.

5. The Implementation of the Master Plan in Yannawa District:

5.1 The original JICA master plan:

Under the Bangkok Metropolitan Administration's master plan for sewerage systems which was prepared by JICA in 1981, the sewerage area in Yannawa District was designated as Zone 3,having a space of 25 square kilometers, and designed to serve about 500,000 people in the year 2000, of which the scope of works of interest can be summarized as follows:

The waste water treatment plant will have a capacity of 119,400 cubic meters of treated water per day. It will be constructed in the area of the mouth of Chong Nonsee Canal. The site utilises 68.75 rai of land.

The collection system will be a separated system with trunk mains, sizes dia.1,000-2,100 mm., approximately 7,600 meters long, and sizes dia.200-900 mm., approximately 604,900 meters long, and with two uplifts.

5.2 The implementation of the master plan:

The BMA will carry out the improvement and construction of two important roads in the project area, i.e. the improvement of Rama III Road and the construction of new roads on both sides of Chong Nonsee Canal from Surawong Road to Rama III Road. In order to avoid the problem of road digging at later times, the Bangkok Metropolitan Administration has a policy to construct waste water drainages in both roads together with the construction of the roads and rain water drainpipes. Therefore, preparations for drainpipe laying have been made as follows:

Rama III Road: Preparation to lay receiving pipes as follows:The inner side,pipes of sizes dia.250mm.- 700 mm., with a total length of 7,630 meters.

The roads along Chong Nonsee Canal: Preparation as follows: The east side, pipes of sizes dia.1,100 mm.- 1,650 mm., totalling a distance of 3,360 meters.

The west side, pipes of sizes dia.350 mm. - 600 mm., totalling a distance of 1,590 meters.

Every road will be slantwise toward the mouth of Chong Nonsee Canal which is the construction site of the waste water treatment plant.

5.3The limitations to the implementation of the master plan:

The recommendation under the master plan of JICA and the condition of existing limitations make it necessary to redesign of the sewerage system in the area of Zone 3 by the reasons that:

1. The treatment plant is designed to fill in too small space which is infeasible to receive the high volume sewerage of the whole zone.

2. It is necessary to divide the area of Yannawa District

into small sewerage centers, depending on the availability of a space in that area.

3. Regarding the collection system, particularly line of trunk mains needed to be changed to cope with the net work, such as the new roads constructed, some should be redesigned to designate as trunk main lines, eg. the roads running along Chong Nonsee Canal.

6. Methodology :

The BMA will employ a consultant engineering company experienced in this field to run this project under the supervision of the Department of Drainage and Sewerage, and this must be relayed to the attention of the Sub-committee on the Prevention and Solution of the Problems on Floods, Waste Water and Refuse Disposal in Bangkok Metropolis and Periphery , soon to be appointed by the government so as to request government support regarding investment. In addition, there will be a committee of qualified persons to assist with advice. The working means are as follow:

6.1 The details and steps of working of the consultant engineering company:

The consultant engineering company will at least have to work as follows in order to reach the targets:

6.1.1 Preliminary data survey:

- To collect data and results of studies on original matters concerned in order to study and analyse them in consistent with the current situation
- To survey for additional data until the need is met.
- To analyse existing data and anticipate various changes in the future.

6.1.2 Concept definition and project limitation:

- To fix the various sewerage zones in the project area of Yannawa District.
- To define the limitations to the designing of the sewerage system fitting to the pollution load and the plant construction site which has an area of about 20 rai of land.
- To fix the various components of the collection system and the waste water treatment plant.
- To study additional details for use in engineering design for all kinds of construction.

6.1.3 Detailed design:

- Final engineering designs of various constructions, both the collection system and the waste water treatment plant to be constructed in the area of the mouth of Chong Nonsee Canal.
- Specifications of various machines and facilities to be used.
- Details of the cost estimation of various constructions.
- Construction work and budget allocation plans.
- Bid documents.

6.2 Project implementation plan:

From the project implementation plan it can be summed up that this project will begin in July 1989 and last through November 1991, the sequence of which can be summarized as follows:

- The preparation of the project will begin in July 1989 and last through the budget for the fiscal year 1990, approved in September 1988 The project will be submitted to the Sub-committee on the Prevention and Solution of the Floods, Waste and Refuse Disposal in Bangkok Metropolis and Periphery.

- The employment to consultant engineering company will begin in October 1989 and last through March 1990.

- The consultant engineers should be able to start the job in March 1990 and last through November 1991, totalling 20 months of working time.

- The survey for additional preliminary data should have a working period running from March 1990 to December 1990.

- The study of the specifications of the various constructions under the project should be done during October 1990 to June 1991.

- The design of the various construction details and the preparation of bid documents should be done during May 1991 to November 1991.

6.3 Resources needed are as follows:

6.3.1 Labour forces:

Expatriate	44	m-m
Local	125	m-m
Supportion staff	350	m-m

6.3.2 Administration :

Since the Yannawa District Sewerage System Project is an important task, the Department of Drainage and Sewerage will establish a project office corresponding personnels to job descriptions will be working staff.

6.3.3 Facilities :

1. One pickup truck
2. Two motorcycles
3. Three set of working desks with chairs
4. Three two-door cabinets

7. Project expenses:

The budgets used for this project will be as follows:

7.1 The budget for employing the consultant engineering company to work for the attainment of the said objectives and targets is approximately 50 million Baht .

7.2 The budget for procuring equipment and facilities for the personnel of the Department of Drainage and Sewerage who have to work jointly with the consultant engineering company, such as the cost of vehicles and the cost of desks, is not yet available.

Only the total wage of the consultant engineer for this project is about 53,000,000.- Baht.

8.Problems and obstacles:

The problems to be occurred are likely to be :

1.Obstacles deriving from the policies of administrators: When there is the change of the staff of administrators, policies may change; the project may be halted.

2. Budgets and support from sources of capitals for the sewerage system construction project.

9. The benefits of the project:

The problem of water pollution in Bangkok Metropolis is becming more entangled unless efficient and effective actions are taken seriously, water quality in the dowm stream of the Chao Phraya River will be polluted like water in canals. Therefore, the implementation of this project will yield a great deal of benefits eg:

1. It can reduce the rates of sickness from alimentary canal complaints, skin diseases or other epidemic diseases suffered by the people .

2. It can reduce dirtiness causing environmental pollution and the dirtiness of public water sources, which in addition to effects on health will bear effects on the mental health of the society.

3. It paves the way for the cooperation of private individuals in equipping their own sewerage systems before releasing water into public water sources .

4. It will be a milestone to the Bangkokians' awareness and encouraging them assist solving the problem of water pollution with a strong will of cooperation .

5. In the near future it can render good understanding between the BMA and Bangkokians to cooperate solving the same problem , particularly under the master plan, in other sewerage zones.

10. Project monitoring and evaluation

The Waste Water Treatment Plant Division, Department of Drainage and Sewerage. will be the representative to act, supervise and coordinate the work, jointly with the consultant engineering company throughout. In addition, the BMA has issued the order No.2633/2531 dated September 5,1988,for the appointment of the Committee Implementing the Sewerage System Construction Project of the BMA, consisting of the Project Supervision Committee and the Project Advisory Committee, authorising the power and duty to assist with advice on various activities under this project.

SEWERAGE SYSTEM PROJECTS

Project : The study of the systematic operation for the improvement of water quality in canals in Bangkok.

Objective :
1. Set up a mathematical model to improve the water quality in canals
2. Manage a data base of operation
3. Officials training
4. Assessment of water quality in canals

Progress :
1. Assistance from JICA to study the water quality in canals in the 350 square kilometers within 14 months
2. A progress report for the operation during June to August 1988 has been submitted to the Department of Drainage and Sewerage.
3. Final report organised in Japan is going to be finished.

Budget : Baht 10 million

Project : Water Treatment at area 2A

Objective : Set up the Water Treatment Plant with capacity of 135,000 cubic meters per day for the population of 252,400 in the project.

Progress : Due to the area in Sipraya is more necessary ,BMA has to hold the area 2A.

Project : Water Treatment in Sipraya Area

Objective :
1. Set up a Water Treatment Plant at the end of Sipraya Road with the capacity of 30,000 cubic meters per day
2. To identify the subzone of the treatment system appropriate to the site of the water treatment plant which has to be located at the end of Chongnonsee canal.

Progress :
1. Chulalongkorn University has been subcontracted to study and design the water treatment plant.
2. Divison of sewerage has study and design the sewage system.

Budget : Bath 2.8 million for progress 1 and 2

Bath 40 million for the objective 3

Project : Study and find out details of the plants for the subzones relaying the sewerage to Chongnoncee plant.

Objective : This project consists of:

1. Collection system appropriate to the existing sewer especially those in the road parallel to Chongnonsee canal to the Suriwong Road and those along the Praram 3 Road.

2. The Treatment plant should be suitable for the area of 20 rai with the capacity of 120,000 cubic meters per day.

3. Interceptors for Krungkasem Road should be located to relay some sewage through Krungkasem Canal to the Sipraya Plant.

4.Interceptors parallel to Krungkasem Canal with the sewage pump station, capacity 24 cubic meter/min. will be constructed.

5.The sewage pump station will be located at Praram 4 Rd.

6.The rain drainage system from Sipraya Road to the plant will be used for sewerage.

Project : Study for designing the treatment plants on Thonburi area.

Objective : Subcontract the consultant company to

1.Design the treatment plants and system for the suburb of Thonburi area (zone 11) which contains the districts of Pasicharoen Nongkam,Talingchan Bangkuntian covering the area of 395 square kilometers with population of 740,000

Progress : Mahidol university is undertaking the feasibility study of the treatment plant and system for the districts of Pasicharoen, Talingchan, Nongkam with the budget of Baht 1.6 million.

FISCAL YEAR 1991 PROJECTS IN NATIONAL RESOURCES AND ENVIRONMENTAL DEVELOPMENT

UNDER THE SIXTH NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT PLAN

In the fiscal year 1991, there will be 38 projects concerning the National Resources and Environmental Development with a total budget of Baht 276 million already approved by the cabinet. The projects are under the responsibility of 7 ministries, classified as follows:

1. New projects on Conserved National Resources 5 projects, eg. qualified boundaries along the rivers of Ping, Wang, Yom, Nan, Mool, Chee to be the resources of the water shed,wildlife protection, national parks. Total budget is Baht 54.72 million, with the operation period ranging from 1-5 years.

2. New projects on Environmental and Cultural Conservation : 10 projects, eg. environmenal conservation on the beaches of Maepim, Rampueng in Rayong province, conservation of the ancient city and facility development in Kampangpet. Total budget is Baht 91.84 million, with the operation period ranging from 1-2 years.

3. New projects on Water Pollution : 11 projects,eg. a study on Waste Water Treatment Plant on Puchao Smingprai Road, construction of Waste Water Treatment Plant in Sriracha. Total budget is Baht 102.01 million, with the operation period ranging from 1-2 years.

4. New projects on Air and Noise Pollution : 4 projects, eg. improvement of the factories releasing pollutions of chemicals and smelly substances, reduction of polluted toxic gases and noise in Bangkok Metropolis. Total budget is Baht 19.55 million, with the operation period ranging from 1-2 years.

5. New projects on Refuse and Night soil : 5 projects, eg. a study on the refuse and garbage disposal system in Samui island, improvement of refuse disposal plant in district of Changpuek, Chiengmai province. Total budget is Baht 3.34 million, with the operation period ranging from 1-7 years.

6. New projects on Toxic Substances : 3 projects, eg. publicity of toxic substances, a study on adjustment of the measures and regulations applied on industrial toxic substances control. Total budget is Baht 4.89 million, with the operation period ranging from 1-5 years.

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NATIONAL ENVIRONMENTAL QUALITY ACT

1. Duties of the National Environment Board

The National Environment Board has the duties as follows:

(1) to submit policy and opinion concerning the improvement and conservation of environmental quality to the Council of Ministers;

(2) to consider the implementation of policy in respect of the schemes or projects concerning the environmental quality;

(3) to consider and submit opinion on projects of Government agencies, State enterprises and private organizations, which may have adverse effect on the environmental quality, to the Council of Ministers or Government agencies concerned;

(4) to submit plans for the development, improvement and conservation of environmental quality to the Council of Ministers;

(5) to give advice to the Prime Minister on matters to be prescribed in the Notification issued under Section 17 or the Order issued under Section 20 of this Act;

(6) to recommend the standards of environmental quality to Government agencies having the statutory power to prescribe them as well as to recommend measures for the prevention and conservation of environmental quality in various respects to the Government agencies concernned;

(7) to recommend any amendment of or improvement to the law concerning the prevention and conservation of environmental quality to the Council of Ministers;

(8) to co-ordinate works between Government agencies, State enterprises and private organizations on matters concerning the environmental quality;

(9) to submit opinion to the Prime Minister for consideration and order in the case where any Government agency or State enterprise violates or does not comply with the laws, rules or regulations concerning the conservation of environmental quality, which may cause extensive damage;

(10) to submit report on the national situation of enviromental quality to the Council of Ministers at least once a year;

(11) to consider any other matter concerning the environmental quality as the Council of Ministers or the Prime Minister may request;

(12) to perform other functions as may be designated by law to be those of the National Environment Board.

In the performance of above-mentioned duties, the National Environment Board may entrust the Office of the National Environment Board with the operation or submission of recommendations to the National Environment Board for further proceedings.

2. Components of the National Environment Board

The National Environment Board consists of the Deputy Prime Minister designated by the Prime Minister as the Chairman, the Permanent-Secretary of Ministry of Defense the

Permanent-Secretary of Ministry of Agriculture and Co-operatives, the Permanent-Secretary of Ministry of Communications, the Permanent-Secretary of Ministry of Interior the Permanent Secretary of Ministry of Science, Technology and Energy, the Permanent- Secretary of Ministry of Public Health, the Permanent-Secretary of Ministry of Industry, the Secretary-General of Interior, the Permanent Secretary of the National Economic and Social Development Board, not more than five persons qualified in ecology and not more than five representatives ofindependent institutions on organizations or other persons appointed by the Council of Ministers as members and the Secretary-General of the National Environment Board as memberand Secretary.

Members appointed from the representatives of independent institutions or organizations or other persons shall not be a government official, official of a State enterprise or local government official having, or receiving regular salaries.

3. Duties of the Office of the National Environment Board
Office of the National Environment Board has the duties as follows:

(1) to perform the works as may be entrusted by the National Environment Board

(2) to study and analyse the environmental conditions and quality to be used for planning and determining the standard of the national environmental quality as well as to formulate guidelines for the enhancement of the national environmental quality;

(3) to recommend the National Environment Board for adopting measures with a view to improving and enhancing the national environmental quality;

(4) to check and evaluate the result on the compliance with or enforcement of the laws, rules and regulations concerning the prevention and conservation of environmental quality by Government agencies, State enterprises and private organizations in order to report to the National Environment Board.

(5) to receive for consideration and remedy a petition from any person who has been aggrieved or damaged by an act which has adverse effect on the environmental quality;

(6) to perform the duty as the centre of co-ordination and public relations in respect of the environmental quality within the country and with foreign countries;

(7) to encourage or carry out the study, research and propagation of problems of the environmental quality in co-operation with educational establishments and other agencies:

(8) to promote and encourage the study of the environmental quality at every level of education;

(9) to perform other functions as may be designated by law to be those of the Office of the National Environment Board.

4. Authorities under National Environmental Quality act

4.1 The National Environment Board shall have the power to acquire Government agencies, State enterprises and other persons to submit documents on the survey of consequences affecting the environmental quality and documents or data concerning the projects and schemes for its consideration and may, in this connection, summon a person concerned to give explanation thereof. If it is of the opinion that any project or scheme may cause gross damage to the environmental quality, it shall recommend remedial measures to the Council of Ministers.

4.2 The National Environment Board or the Office of the National Environment Board may invite any person to give fact, explanation, or technical opinion or advice as it deems fit and may ask for co-operation from any person with a view to ascertaining any fact or surveying any activity which may have adverse effect on the environmental quality.

4.3 The National Environment Board may appoint an adhoc committee to consider or carry out any matter as may be entrusted by the National Environment Board. The adhoc committee may appoint a sub-committee to consider or carry out any matter as may be entrusted by the adhoc Committee.

4.4 According to section 17 of this Act, the Prime Minsister shall, with the advice of the National Environment Board, have the power to issue Notifications in the Government Gazette, Prescribing the followings:

(1) categories and magnitude of projects or activities of Government agencies,

State enterprises or private organizations, which are required to submit report concerning the study and measures for the prevention of and remedy for the adverse effect on the environmental quality during the preparation stage (EIA report) to the National Environment Board for consideration and approval before further proceedings;

(2) standards of environmental quality which, by law, are not within the scope of power and duty of any Government agency:

(3) methods to be used for checking environmental qualiy.

4.5 Section 18 states that in the case where there is a Notification regarding the EIA, the official invested by law with the power and duty to consider and grant a permit or renewal of a permit to any person in order to enable him to carry out any project or activity shall submit a report concerning the study and measures for the prevention of and remedy for the adverse effect on the environmental quality during the preparation stage of such applicant to the Office of the National Environment Board for consideration and approval before further proceedings.

After the said official has submitted a report concerning the study and measures for the prevention of and remedy for the adverse effect on the environmental quality during the preparaion stage under paragraph one, the Office of the National Environment Board shall consider the report within ninety days from the date of receiving such report. If the Office of the National Environment Board does not finish its consideration within the said period, it shall be deemed that the Office of the National Environment Board has granted its approval to it in accordance with the first paragraph.

In the case where the Office of the National Environment Board gives its approval under paragraph one, the said official shall grant the permit or renewal of permit to the applicant.

In the case where the Office of the National Environment Board dose not give its approval under paragraph one, the said offcial shall delay the grant of permit or the renewal of permit to the applicant until such person has submitted measures for the prevention of and remedy for the adverse effect on the environmental quality to which the Office of the National Environment Board Can give its approval.

After such person has submitted measures for the prevention of and remedy for the adverse effect on the environmental quality under paragraph four, the Office of the National Environment Board shall consider the said measures within thirty days from the date of the submission; if the Office of the National Environment Board dose not finish its consideration within the said period. It shall be deemed that the Office of the National Environment Board has granted its approval thereto under paragraph four and the said official shall grant a permit or a renewal of permit to the applicant.

4.6 For the purpose of carrying out the activities under Section 18, the National Environment Board may request any Government agency, or Government educational institution, as it thinks fit, to make a report concerning the study and measures for the prevention of and remedy for the adverse effect on the environmental quality.

The National Environment Board may authourize an expert in the study of the adverse effect on the environmental quality to make a report of study and measures for prevention of and remedy for the adverse effect on the environmental quality.

The application for and the grant of a permit, the qualifications of the expert, the order suspending or revoking the permit, and the control of the activities of a licensee shall be in accordance with the rules, conditions, and methods prescribed in a Ministerial Regulation and the fees for the application for and the grant of a permit shall be in accordance with those prescribed in the Ministerial Regulaion.

4.7 The highest power is stated in Section 20 that if there is an emergency arising from environmental pollution, which, if left unremedied, will be dangerous to life, or will cause personal injury or damage to the properties of the people or the State, the Prime Minister shall have the power to issue an order prohibiting the person from causing such danger or damage or the person who may be in danger or suffer any damage from acting in any way which will intensify the severity of such environmental pollution, or issue an order that certain acts be carried out in order to stop or reduce the severity of the environmental pollution during the emergency.

The Prime Minister may delegate the power to issue the order under paragraph one to the Changwat Governor to exercise such power within the Changwat area on behalf of the Prime Minister by issuing the order to that effect and publishing it in the Government Gazette.

After the Prime Minister has issued the order under paragraph one or the Changwat Governor acting on his behalf has issued the order under paragraph two, the said order shall be published in the Government Gazette without delay.

4.8 Section 21 states that in the case where there is a reasonable ground for suspecting that there is violation of or non-compliance with any law, rule or regulation concerning the control of environmental quality, the order of the Prime Minister or of the Changwat Governor acting on behalf of the Prime Minister under Section 20, the comepetent official shall have the power to enter any premises or vehicle during sunrise and sunset or during office hours in order to inspect the said violation or non-compliance.

In the performance of duty by the competent official under paragraph one, the owner or occupier of premises or vehicle or any person concerned shall provide him with reasonable facility.

4.9 The performance of duty under Section 21 shall be done in the presence of the occupier of the premises or vehicle, if such person cannot be found, it shall be done in the presence of at least two other persons requested by the competent official to attend as witnesses.

4.10 In performing his duty, the competent official must produce his identity card at the request of the person concerned.

An identity card of competent official shall be in such form as prescribed in a Ministerial Regulation.

4.11 In performing his duty, the competent offcial shall be official under the Penal Code.

4.12 The Prime Minister shall have charge and control of the execution of this Act and shall have the power to appoint competent officials, issue Ministerial Regulations prescribing fees not exceeding the rates attached hereto a prescribing other Activities and issue Notifications for the execution of this Act.

Penalties : (1) Whoever violates or fails to comply with a Notification of the Prime Minister issued under Section 17 (2) shall be liable to imprisonment for a term not exceeding one month or to a fine not exceeding one thousand baht or to both.

(2) Whoever violates or fails to comply with an order issued under Section 20 shall be liable to imprisonment for a term not exceeding six months or to a fine not exceeding ten thousand baht or to both.
In the case where the person who violates or fails to comply with said order is the person who causes danger or damage, he shall be

liable to imprisonment for a term not exceeding five years or to a fine not exceeding fifty thousand baht, or to both.

(3) Whoever obstructs or fails to provide facility to a compete official in the performance of his duty under Section 21 shall be liable to imprisonment for a term not exceeding one month or to a fine not exceeding one thousand baht or to both.

Sources: (1) National Environmental Quality Act. BE 2518, published in the Government Gazette, Vol, 93, Part 40, Special Issue, dated Fabruary 19, B.E. 2518 (1975)

(2) National Environmental Quality Act. (No. 2) B.E. 2521 , published in the Government Gazette Vol. 95, Part 156, Special Issue, dated December 31, B.E. 2521 (1978)

(3) National Environmental Quality Act. (No.3) B.E. 2522 published in the government Gazette Vol. 96, Part 40, Special Issue, dated March 23, B.E. 2522 (1979)

REQUIREMENTS REGARDING THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

1. Types and Sizes of Projects or Activities Requiring Environmental Impact Assessment (EIA) Reports

2. License for Preparation of Environmental Impact Assessment Report
    - 2.1 Qualification of Applicant
    - 2.2 Qualification of Expert
    - 2.3 Qualification of Staff
    - 2.4 Conditions Prescribed in License
    - 2.5 Suspending the License
    - 2.6 Revoking the License

3. The Board of Investment Regulation Concerning Environmental impact Assessment

REQUIREMENTS REGARDING
THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

1.Types and Sizes of Projects or Activities Requiring Environmental Impact Assessment (EIA) Reports

Items	Types of Projects or Activities	Sizes
1	Dam or Reservoir	storage volume greater than 100,000,000 cubic meters or storage surface area greater than 15 square kilometers
2.	Irrigation	irrigated area greater than 80,000 rais (12,800 hectares)
3	Commercial Airport	all sizes
4.	Hotel or Resort Facilities environmentally sensitive area such as areas adjacent to rivers coastal areas, lakes or beaches or in the vicinity of national parks	greater than 80 rooms
5	Mass Transit System and Expressway as defined by the Announcement of the Revolutionary Party No. 290, 24 November B.E 2515	all sizes
6	Mining as defined by the Mineral Act No.1 B.E. 2510, No.2 B.E. 2516 and No. 3 B.E. 2522	all sizes

Items	Types of Projects or Activities	Sizes
7	Industrial Estate as defined by the Industrial Estate Authority of Thailand Act, B.E. 2522	all sizes
8	Commercial Port and Harbour	with capacity for vessels of greater than 500 ton-gross
9	Thermal Power Plant	Capacity greater than 10 MW
10	Industries	
	(1) Petrochemical Industry	greater than 100 tons/day of raw materials required in production processes of oil refinery and/or natural gas separation
	(2) Oil Refinery	all sizes
	(3) Natural Gas Separation of Processing	all sizes
	(4) Chlor-Alkaline Industry requiring NaCl as raw material for production of $Na_2 Co_3$, NaOH, HCI, Cl_2, NaOCI and Bleaching Powder	production capacity of each or combined product greater than 100 tons/day

Items	Types of Projects or Activities	Sizes
	(5) Irons and/or Steel Industry	requiring from ore and/or scrap iron as raw materials for production greater than 100 tons/day or using furnaces with combined capacity greater than 5 tons/batch all sizes
	(6) Cement Industry	all sizes
	(7) Smelting Industry other than Iron and Steel	production capacity greater than 50 tons/day
	(8) Pulp Industry	production capacity greater than 50 tons/day

Sourec : Notification of the Ministry of Science, Technology and Energy, B.E. 2524 Issued under National Environmental Quality Act, B.E. 2518 as amended in B.E. 2521, published in the Royal Government Gazette (Special issue), Vol, 98, Part 158, dated September 27, B.E. 2524 (1981)

2. License for Preparation of Environmental Impact Assessment Report

2.1 Qualification of Applicant

The EIA reports which are required to be approved for permitting procedure can be prepared only by the persons or parties who have license from the National Environment Board. The applications for the license is limited to the following applicants:

(1) Educational institution or Research institution as juristic person under Thai laws.

(2) Juristic person under Thai law as follows:
- (A) All share holders of Registered Ordinary Partnership must be Thai nationnlity
- (B) Unlimited responsibility share holder of Limited Parnership must be Thai nationality and capital of Limited Partnership not less than 51% must belong to share holder who is the person with Thai nationality.
- (C) Committee of Limited company not less than half must be Thai nationality and capital of such company not less than 51% must belong to share holder who is ordinary person with Thai nationality.

(3) Juristic person under foreign law must join juristic person as in article (1) or article (2) who is granted a license in order to be eligible for preparting EIA report.

(4) State Enterprises, as established by a specific Act, only for their own activities.

(5) Mining Industry Council, as established in accordance with the law, only for the members' activities.

The applicant in article (1) and article (2) must have head office in Thailand. The applicant in article (2) and article (3) must be in the business of research and technical consultation

2.2 Qualification of Expert

The applicant mentioned above must have at least one full-time expert taking responsibility for preparation of EIA report and he/she must meet the following qualifications:

(1) The expert is holder of not less than a Bachelor degree or equivalent in

(a) Environmental science, Ecology or Sanitary science
(b) Environmental engineering or Sanitary engineering
(c) Environmental economics.

(2) The export must have experience in the field of improvement and conservation of environmental quality in accordance with the notification of the National Environment Board as follows:

(a) The expert with Doctoral degree or equivalent must have experience in the field of improvement and conservation of environmental quality for not less than 1 year.

The expert with Master degree or equivalent must have experience in the field of improvement and conservation of environmental quality for not less than 3 years.

The expert with Bachelor degree or equivalent must have experience in the field of improvement and conservation of environmental quality for not less than 5 years.

(b) The expert must have worked in this field in government sector, State Enterprises, International organization, Foreign Government agencies or in the business of environmental consultation and he/she must be involved in preparation of the following reports, fully or partially:

1) Report concerning study and measures for protection and improvement of impacts on the environment.
2) Planing, Management, study and research concerning environment such as pollution, ecology, conservation, arts and culture.

(c) The qualification of expert must be approved by a committee appointed by the Secretary-General of the National Environment Board. This committee is composed of not less than 5 but not more than 8 persons.

(d) The applicant must be able to prove to the committee that his/her expert has enough experience in the field of the required qualifications. Office of the National Environment Board will submit the recommendation concerning the expert to the National Environment Board for licensing.

3. The expert has not been involved in false or fraudulent EIA report during the past three years.

The National Environment Board has authorities to accept ecpert who dose not qualify as described in (1) under certain condition.

2.3 Qualification of Staff

The applicant must have at least three full-time staff taking responsibility for preparing EIA report and these staff must meet the following qualifications:

(1) They must be graduated in Science, Engineering or Social Science.

(2) They have not been involved in false or fraudulent EIA report during the past three years.

2.4 Conditions Prescribed in License

Permiting a person to prepare EIA report, the National Environment Board can prescribe the conditions which licensee must perform and the scope, nature, and type of activities that licensee is allowed to prepare EIA reports

2.5 Suspending the License

The National Environment Board has authorities to suspend the license, when:

(1) The licensee prepares a report carelessly which may cause damage to public.

(2) The licensee allows expert or staff who has been suspended or revoked the license to prepare EIA report.

(3) The licensee violated or fails to comply with the condition prescribed in the license.

The suspension in article (1) is not less than 6 months, but not more than 12 months at a time and the suspension in article (2) or article (3) is not less than 3 months but not more than 6 months at a time, depending on situation.

2.6 Revoking the License

The National Environment Board has authorities to revoke the license when:

(1) the licensee lacks qualification as described in article 2.1

(2) The Licensee dose not provide expert(s) or staff as described in article 2.2 and 2.3

(3) The significant information in application form fails to reflect the fact, fully or partially

(4) The licensee, who once was suspended the license, violated regulation in article 2.5 again

(5) The licensee prepares false or fraudulent report

(6) The licensee violates or fails to comply with this Ministerial Regulation

(7) The licensee violates or fails to comply with the conditions prescribed in license and such conditions state that the license will be revoked if the licensee violates or fails to comply with the conditions.

source : (1) Ministerial Regulation NO.2 B.E.2527 issued under National Environmental Quality Act, B.E. 2518 as amended in B.E.2521, published in the Royal Government Gazette, Vol.101, Part 184, dated December 12, B.E.2527(1984)

(2) Notification of the National Environment Board No.7/2528 by virtue of Article 4(1) (b) of Ministerial Regulation No.2 B.E. 2527 issued under National Environment Quality Act, B.E.2518 as amended in B.E. 2521

(3) Ministerial Regulation NO.3 B.E.2529 issued under National Environmental Quality Act, B.E. 2518, Published in the Royal Government Gazetted, Vol. 103, Part 140, dated August 8, B.E. 2529(1986)

3. The Board of Investment Regulation Concerning Environmental Impact Assessment

The Investment Promotion Act B.E. 2520 (1977) is administered by the Board of Investment (BOI) whose function is to promote domestic and foreign investment considered important and useful to the social and economic development of Thailand. To facilitate investors in obtaining all permits and registration to start business or operating factory, the One stop Service Center was established in the way that investor can contact only this office for permitting process.

In environmental quality control, The Investment Promotion Act states in Section 19 that the investment project to which the Board may grant promotion shall be one which incorporates appropriate measures for the prevention and control of adverse effects on environmental quality in the interest of the common good of the general living of the public and for the perpetuation of mankind and nature, and Section 20 stated that in the case where the Board deems it appropriate to grant promotion to any applicant, the Board may stipulate conditions on prevention and control of the damage of environmental quality.

For those applicants of the projects which are required to prepare Environmental Impact Assessment under the National Environmental Quality Act, as mentioned in section B (1) entitled "Types and Sizes of Projects or Activities Requiring Environmental Impact Assessment Reports", must submit EIA report to the One Stop Service Center for further review by Office of the National Environment Board.

Once an application has been submitted to One Stop Service Center, it will be checked immediately for completeness , if it contains insufficient details or not correspond to the required conditions, the Center will return the application within five days from the date of receipt.

If it is requested by the applicant, and if it is necessary, the Center may inform the applicant within 20 days from the date the application recieved, whether or not the application will be approved and under which conditions, so that the investor can proceed further with his project without having to wait for procedure of issuing the license.

In case that the application is in complete form which contain sufficient details the Center will inform the applicant of th final decison, whether his application is approved or not within 90 days, this should not include the time that the application is returned for amending.

Source : (1) The Investment Promotion Act. B.E. 2520 (1977)
(2) Regulation concerning the Establishment of One Stop Service Centre B.E. 2525 (1982) published in the Royal Government Gazette (special issued) Vol 99, Part 125, dated September 3,B.E.2525 (1982)

NOTIFICATION OF THE MINISTRY OF INDUSTRY

No. 1 (B.E. 2512)

Issued under the Factory Act B.E. 2512

Re : Factories which operate only as components necessary for other purposes than factory operation

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By Virtue of the provision of Sectoion 6 (3) of the Factory Act B.E. 2512, the Minister of Industry hereby issues a notification, as follows:

Clause 1. Factories of all categories or kinds which operate only as components necessary for the prospecting, mining, ore dressing, petroleum exploration or petroleum production under the law on minerals, and such operation is only to render services to their own undertakings in respect of the prospecting, mining, ore dressing, petroleum exploration or petroleum production under the law on minerals, shall be exempt from complying with all provisions of the Factory Act B.E.2512.

Clause 2. Factories of all categories or kinds which operate only as components necessary for rendering services to offices, associations, clubs, dwelling places, places of amusement, stadiums, hotels, places of entertainment under, the law on places of entertainment, restaurants or bars, and such operation is only to render services to their own offices, associations, clubs, dwelling places, places of amusement, stadiums, hotels, places of entertainment under the law on places of entertainment, restaurants or bars, shall be exempt from complying with all provisions of the Factory Act B.E. 2512.

Notified on the 1st day of September 2512.
Lieutenant General P.PUNNAKANTA
Minister of Industry.

NOTIFICATION OF THE MINISTRY OF INDUSTRY
No. 2 (B.E. 2513)
Issued under the Factories Act B.E. 2512
Re: Duties of Licensee to Operate Factory

By virtue of Section 39 of the Factories Act B.E. 2512, the Minister of Industry hereby prescribes rules and procedures which licensee to operate factory of whatever category or kind is under duty to comply with, as follows:

General Rules and Procedures
Chapter 1
Keeping of Factory and Machinery

Issued by virtue of Section 39 (1)

Article 1. Must provide regular inspection of the condition of factory building, and must maintain or repair the same so that they are secure and safe as the time the licence was granted.

Article 2. Must keep passage and working area clean, even, nonslippery and dry except the area where it may not be possible to do so.

Article 3. Must keep railings, stairs and floor or passage which are higher than the factory floor from 1.50 meters onwards in secure condition.

Article 4. Must store or arrange materials or other things in orderly manner so that they do not interfere with or obstruct passage or work and cause accidents.

Article 5. Must inspect and keep exits and emergency stairs in condition for immediate evacuation when there occurs an emergency.

Chapter 2

Emergency Exits in Factory

Issued by virtue of Section 39 (2)

Article 6. Emergency exit must be of at least 110 centimeters in width, but if the number of people using this exit exceeds 50 persons it must be widened at the ration of at least 2 centimeters per person.

Article 7. Must maintain emergency exit door in condition that it can easily be opened by workers at any time during work.

Article 8. Must maintain adequate lights and must not permit obstruction of exits or emergency stairs or passage which will be used in emergency.

Article 9. Emergency exit of a factory which has more than 50 workers must have substitute lighting system in case the regular lighting system fails; provided, in adequate size and number for emergency exit.

Article 10. Must provide and maintain clear posters or signs for exits or emergency stairs which are not in regular use, so that workers are continuously aware of the emergency exits or stairs.

Chapter 3

Danger Alarm

Issued by virtue of Section 39(3)

Article 11. A factory which contains gas that may endanger persons, or has inflammable material and more than 50 workers, or has combustible material and more than 100 workers must provide danger alarm which gives clear and adequate warning to workers in danger area to evacuate immediately and to notify officials concerned to prevent the danger quickly.

Article 12. Must provide danger alarm in at least two-different points which must be in safe area away from the above mentioned danger, and must be in position where a person can easily and quickly activate the danger alarm.

Article 13. The danger alarm under the preceding Article must be of the type which does not require energy from lighting system and is used for machinery.

Chapter 4

Fire-Fighting Equipment and Other Equipment for Extinguishing Fire and Means of Fire Prevention

Issued by virtue of Section 39(4)

Article 14. Fire operation of a factory may cause fire: Factory buidings or warehouses which are constructed with combustible materials, the storage of combustible materials must be provided with adequate fire-fighting equipment, in proportion to condition, size and nature of the factory, to be located at different points within the compound of factory for accessibility. Provided, there must not be less than one fire extinguisher per area of 100 square meters, fraction of 100 square meters is to be counted as 100 square meters.

Article 15. One fire extinguisher means the following fire extinguisher or other equipment for extinguishing fire:

(1) acid-soda type or water sprayed by gas type of extinguisher, with capacity of not less than 10 litres;
(2) foam gas type of extinguisher, with capacity of not less than 10 litres;
(3) carbon dioxide type of extinguisher, with capacity of not less than 5 kilograms;
(4) dried chemical type of extinguisher, with capacity of not less than 5 kilograms.

Article 16. Chemical fire extinguisher must be of suitable type for the kind of fire which may be caused as follows:

(1) acid-soda type or water sprayed with gas type for extinguishing ordinary fire i.e. fire caused by wood, paper, cloth. Do not use for extinguishing fire caused by electrical equipment, various type of oil, alcohol, acetone or calcium carbide;
(2) foam gas type for extinguishing ordinary fire or fire caused by various types of oil, alcohol,or acetone. Do not use for extinguishing fire caused by electrical equipment or calcium carbide;
(3) Carbon dioxide type for extinguishing all kind of fire but not in a windy or an open area;

(4) Dry chemical type for extinguishing all kind of fire.

Article 17. Fire extinguisher must be in usable condition and must have record of installation, refill or change of chemical as well as necessary inspection and the recommendation of manufacturer. Inspection must be carried out not less than once every six months.

Article 18. Must provide training session for workers on the use of fire-extinguisher and practical knowledge in case of fire.

Chapter 5

Refuse Disposal, Drainage and Ventilation

Issued by virtue of Section 39 (6)

Article 19. Must always keep the factory clean and clear of refuse and must provide refuse receptacle or disposal according to the necessity and suitability.

Article 20. Must separate refuse or unusable material which contains mixture of poison, or cotton wool, cloth or piece of cotton stained with flammable material, in different receptacle with proper lid, and must provide special disposal of the above-mentioned by following safety procedure and without causing annoyance.

Article 21. Must maintain drainage system in good condition and efficiency.

Article 22. Waste water must not be drained from factory except after one or more treatments have been applied and the waste water becomes as follows:

(1) pH value is between 5 and 9;

(2) Permanaganate value must not exceed 60 milligrams per litre;

(3) Dissolved solids must not exceed 2,000 milligrams per litre;

(4) Sulfide calculated as H_2S must not exceed 1 miligram per litre;

(5) Cyanide calculated as HCN must not exceed 0.2 miligram per litre;

(6) Zine, chromium, arsenic, silver, copper, mercury, cadmium, barium, selenium, lead, nickel together or separately must not exceed 1 milligram per litre;

(7) No content of tar;

(8) No content of oil and grease;

(9) Formaldehyde must not exceed 1 milligram per litre;

(10) Phenols and cresols must not exceed 1 miligram per litre;

(11) Free chlorine must not exceed 1 milligram per litre;

(12) No content of insecticide and radioactive chemicals;

(13) If the ratio of waste water and water in public water-ways is between 1:8 and 1:150 the mixture of chemical must not exceed 30 per 1,000,000 parts. If the ratio of waste water and water in public water ways is between 1:151 and 1:300 the mixture of chemical must not exceed 60 per 1,000,000 parts. If the ratio of waste water and water in public water-ways is between 1:301 and 1:500 the mixture of chemical must not exceed 150 per 1,000,000 parts:

(14) Value of B.O.D.(5 days at temperature 20 C) must not exceed 20 milligrams per litre, or may differ from the prescribed limit depending on geographic or nature of drainage as the officials may deem reasonable, but must not exceed 60 milligrams per litre.

(B.O.D. is abbreviation of Biochemical Oxygen Demand)

(15) Temperature of waste water before discharged into public water-ways must not exceed 40 C

(16) Colour or smell of waste water when discharged into public water-ways must not be objectionable.

Article 23. In case of waste water is discharged from Factory directly into the sea or public sewage system it shall be in accordance with what the officials deem reasonable.

Article 24. Must provide appropriate ventilation by having the combine area of doors, windows and air vents, excluding those between rooms, of not less than one-tenth of the working area in the room; or have ventilation of not less than 0.5 cubic meters per minute per worker. Provided, an ordinary factory does not keep or use poisonous, chemical, inflammable, explosive or other dangerous materials or that which creates dust.

Article 25. In occasional work within closed area which has no ventilation, breathing apparatus or adequate ventilating machine must be provided for workers performing their duties, and there must be at least one person at the exit of the area to provide assistance at all time.

Chapter 6

Working Lights

Issued by virtue of Section 39 (7)

Article 26. Must provide all working area with adequate lights which are capable of showing obstructions and moving parts of machinery which may cause danger, or danger from electricity, including stairs and exits in case of emergency.

Article 27. Must prevent direct light or reflection from shining into the eyes of workers during work.

Article 28. Must provide working lights at the working place or point, in accordance with the following rules:

(1) For court-yard, road and passages outside factory building, the brightness must not be less than 20 lux or 2 foot-candle.

(2) For area where work which requires no precision is carried out, i,e., loading and transferring of materials, rough selection of materials, grading earth, stones or similar materials, and passage inside factory building, the brightness must not be less than 50 lux.

(3) For area where slightly refined work is carried out, i.e., manufacturing steel products or semi-finished steel, parts assembling, rice milling, cotton combing or first stage performing in manufacturing method, and the area of machinery room, boiler room, lift, containers room, stocks or small finished products room, changing room, bathroom and lavatory, the brightness must not be less than 100 lux.

(4) For area where work of semi-precision is carried out, i.e., semi-precise parts assembling, rough lathe work or metal polishing, incomplete examination, sewing light colour cloth or leather, food canning, plaining, veneering, the brightness must not be less than 200 lux.

(5) For area where work of high precision is carried out,i.e., semi-precise lathe work or metal polishing, semi-precise inspection or testing, currying of animal skins, weaving of light colour cotton or fur, working with books, the brightness must not be less than 300 lux.

(6) For area where work of high precision is carried out and the work involves small and precise parts, i.e.,drilling, lathe work, gems cutting or polishing work which requires high precision but consists of different distinguishable colour, precise examination, weaving of dark colour cloth, the brightness must not be less than 500 lux.

(7) For area where work of especially high precision is carried out or work which must be done continuously over a long period, involving small and precise parts and not easily distinguishable colours, i.e.,high-precision assembling of machinery, assembling time piece, testing high precision tools, gems cutting, composing, sewing dark colour cloth, the brightness must not be less than 1000 lux.

Chapter 7

Working Space

Issued by virtue of Section 39 (8)

Article 29. Must provide working area of not less than 3 square meters per worker. The calculation of the area shall include area used for table, machinery, and products or materials which move according to manufacturing method.

Chapter 8

First-Aid Equipment

Issued by virtue of Section 39 (9)

Article 30. First-aid equipment as well as tools must be clean and hygienic and ready for use, at least the following items:

(1) scissors
(2) tongs
(3) rubber tourniquet
(4) clinical thermometer
(5) measuring vessel for medicine
(6) drinking glass
(7) eye-cup
(8) adhesive plaster
(9) bandage
(10) sterilized cotton wool
(11) mercurochrome
(12) acriflavin
(13) tincture of iodine
(14) hydrogen peroxide
(15) ethyl alcohol
(16) aromatic spirit of ammonia

(17) tincture opium camphor
(18) headache and fever remedy
(19) medicine for burns and scalds
(20) boric solution for eye wash

Chapter 9

Lavatories, Urinals and Wash-Places

Issued by virtue of Section 39(10)

Article 31. Must provide lavatories and urinals which can easily be kept clean.

Article 32. Must provide lavatories in proportion to at least one seat for not more than 15 workers, 2 seats for not more than 40 workers, 3 seats for not more than 80 workers, and to increase the number of seats at the ratio of 1 seat for not more than 50 workers. For factory which has male and female workers whose combined number exceeds 15 persons, adequate lavatories must be especially provided for female workers according to suitability

Article 33. Must provide lavatories and urinals on different floors, according to suitability, when factory building has workers on various floors.

Article 34. Area for a lavatory must not be less than 1.5 square meters per one seat.

Article 35. Lavatories and urinals must be of the type that the waste goes into sceptic tanks. The floor must be non-absorbent.

Article 36. Must provide adequate toilet paper and water for each lavatory.

Article 37. Must provide wash-places, including materials and equipment for workers according to necessity and suitability.

Article 38. Must provide adequate ventilation for each lavatory, urinal and wash-room.

Article 39. Must provide daily cleaning of lavatory, urinal and wash-room so that they remain in hygienic condition.

Article 40. Factory which manufactures food-stuff must provide hygienic wash basins, disinfectant or soap at suitable places, in proportion to at least 1 place for not more than 15 workers, 2 places for not more than 40 workers, 3 places for not more than 80 workers, and to increase the number at the ratio of 1 place for not more than 50 workers.

Chapter 10

Clean Drinking Water

Issued by virtue of Section 39 (11)

Article 41. Must provide adequate clean drinking water for consumption by standard of drinkable water, in proportion to at least 1 place for not more than 40 workers, 2 places for not more than 80 workers, and to increase the number at the ratio of 1 place for not more than 50 workers.

Article 42. Must provide and maintain adequate and hygienically clean drinking utensils of vessels.

Notified on the 24th July 2513
Lieutenant General P. PUNNAKANTA
Minister of Industry.

Notification of Ministry of Industry No. 15 (B.E. 2527) issue in accordance with the Factory Act B.E. 2512

Subject : Duty of Licensees to operate industrial plants

By virtue of Section 39 (16) of the Factory Act B.E.2512, the Minister of Industry hereby announces the principles and procedures to be followed by the licensees to operate industrial plants

1. The licensees to operate the following industrial plants must take response to do as specified in 2.
    - 1.1 An industrial plant producing pulp at higher than 50 tons/day
    - 1.2 An industrial plant producing chemical except fertilizer as follows:
        - 1.2.1 Chlor-alkali plant, using Sodium Chloride ($NaCl$) as raw material for the production of Soda Ash (Na_2CO_3), Caustic Soda ($NaOH$), Hydrochloric Acid (HCl), Chlorine (Cl_2), Sodium Hydrochloride ($NaO\ Cl$) and Bleaching Powder each or several combined at higher than 100 tons/day.
        - 1.2.2 An industrial plant producing petrochemicals from the raw materials obtained as by products of the Oil Refinery in the production process at higher than 100 tons/day.
    - 1.3 An industrial plant of any size engaged in crude oil refinery.
    - 1.4 An industrial plant of any size producing cement.

1.5 An industrial plant producing iron and steel, using iron ores or scrap iron as raw material with production capacity higher than 100 tons/day or using melting furnace with the total capacity of 5 tons/bath.

1.6 An industrial plant engaged in are smelting or production of metals at higher than 50 tons/day.

2. Environmental Impact Assessment (EIA) report must be submitted when asking for extension the operation license every 3 years and the report should have detail as described in 3.

3. EIA report must consists of the following items.
   - 3.1 Project description and site selection
   - 3.2 Existing condition of physical and ecological resources such as air, water, land, transportation system, terrestrial, aquatic, raw material resource etc.
   - 3.3 Environmental impact assessment of the project on existing resources.
   - 3.4 Mitigation for protecting and/or enhancing environmental resources.
   - 3.5 Waste recycling scheme
   - 3.6 Environment monitoring program in the area where expected to impact by the project.

Given on the 27th day of January B.E. 2527 (1984)
Signed : Ob Wasuratana
Minister of Industry

PRODUCT AND PRICE LIST OF SOME DISTRIBUTORS

PHOL THANYA CO; LTD.

Type of Business : Distributor of "A O" from USA

Product

1. Respirators Protection
   - 1.1 Toxic Dust Mist Respirator
   - 1.2 Dualcartridge Respirator
   - 1.3 Full Face Respirator
   - 1.4 Dust Mask
   - 1.5 Airline Respirator

2. Face Protection
   - 2.1 Helmet
   - 2.2 Welding Helmet

3. Hand Protection
   - 3.1 Nitrile Glove for solvents oil Acids
   - 3.2 Rubber Coated Glove

4. Eye Protection
   - 4.1 Safety Goggle
   - 4.2 Safety Spectacles
   - 4.3 Welder Goggle

5. Ear Protection

LERTVILAI AND SONS CO; LTD.

Type of Business : Distributor of "INTERSAFE" from Holland
"NIDIN" from Japan

Product :

Item	Price (Baht)
VISTA CLEAR	460.-
VICTOR	450.-
CLIP UP (VICTOR)	95.-
FORTLX S CLEAR	80.-
SERVA S CLEAR	100.-
SERVA S WELDING SHADE 5	100.-
ASTA FLIP UP	240.-
CLARA P NON-MIST	85.-
CLARA H MON-MIST	100.-
VULCA MINI TIP LIFT UP	390.-
INTERMASK	8.-
AIROX JUNIOR DUST	140.-
AIROX JUNIOR VAPOURS	200.-
FILTER AIROX JUNIOR DUST	12.-

FILTER AIROX DUST	60.-
FILTER AIROX VAPOURS	60.-
AIROX DUST	280.-
AIR LINER	5,000.-
SUPERVISOR	3,500.-
NO BEL SAFE CLIP ON	300.-
NO BEL	300.-
INTERDAMP	9.-
AIROX 1	350.-
AIROX 2	420.-
INTERCAP	250.-
NOTRON	200.-
FLEXY	180.-
OTTER	200.-
GRIPE	100.-

P. NARONG P.N.I CO; LTD.

Type of Business : Producer of Safety Helmet

Product :

Helmet	Type	Price (Baht)
	UE	130.-
	E	150.-
	E(Std.)	180.-
	E 010	200.-
	E 011	200.-
	PC-002	160.-
	PC-003	180.-
	PC-001,004	180.-
	AC	90.-
	PN1	85.-
	PU	50.-
	ETC	100.-

SAFETY PRODUCTS CO.,LTD.

Type of Business : Producer "Metal - Toe- Shoes"

	Product	Type 1*	2*	Price Baht
1.	Metal-Toe Shoes	/	/	235.-
2.	Metal-Toe Shoes	/	-	230.-
3.	Metal-Toe Shoes	-	/	220.-
4.	Metal-Toe Boots	/	/	250.-
5.	Metal-Toe Boots	/	-	245.-
6.	Metal-Toe Botts	-	/	230.-
7.	Metal-Toe Combat Boots	/	/	285.-
8.	Metal-Toe Combat Boots	/	-	280.-
9.	Metal-Toe Combat Boots	-	/	270.-
10.	Metal-Toe Zip Boots	/	/	280.-

Type 1* = Feature grease,oil
Type 2* = Stell Toe cap

GENERAL SUPPLY Co., LTD.

Type of Business : Distributor of "NORTH" from USA

Product :

Item	Price(Baht)
1. HAND PROTECTION	
1.1 Nitrile Glove Solvents Oil Acids	600.-
1.2 High Voltage Glove	-
1.3 Hot Mill Glove	700.-
1.4 Rubber Coated Glove	140.-
1.5 Polka Dot Glove	-
2. INDUSTRIAL PROTECTIVE CLOTHING	
2.1 NBR Sleeves For Chemical	550.-
2.2 NBR Apron For Chemical	580.-
2.3 Chemical Clothing	1,650.-
2.4 Spray Paint Clothing	360.-
2.5 Sand Blast Hood	5,500.-

3. HEAD PROTECTION & SAFETY BELT

3.1 Safety Helmet	395.-
3.2 Bumpcap	240.-
3.3 Industrial Safety Belt	-
3.4 Harness Safety Belt	-
3.5 Tool Belt	-

4. PROTECTION FOOTWEAR

4.1 Half PVC Boots	660.-
4.2 PVC Boots	680.-
4.3 PVC Boots W/Steel Toecap	1,200.-
4.4 Ankle Guard	250.-
4.5 Eyewash Bottle	-
4.6 Safety Shoes	1,790.-
4.7 Safety Shoes	1,790.-
4.8 Safety Shoes	2,420.-

5. RESPIRATORS PROTECTION

5.1 Dust Mist Respirator	37.-
5.2 Dust Mask	-
5.3 Dust Mask W/Active Carbon	50.-
5.4 Dualcartridge Respirator	145.-
5.5 Full Face Respirator	6,780.-
5.6 Full Face Respirator	5,000.-
5.7 Airline Respirator	12,150.-
5.8 Paint Spray Airline Hood	-
5.9 Chemical Splash Hood	-
5.10 Self Contained Breathing Apparatus	-

6. HEARING PROTECTION

6.1 Foam Ear Plug/cord	16.-
6.2 Ear Plug/Cord	55.-
6.3 Dielectric Earmuff	335.-
6.4 Sound off Earmuff	425.-
6.5 Industrial Earmuff	500.-

7. EYE PROTECTION

7.1 Safety Spectacles	300.-
7.2 Safety Spectacles	-
7.3 Safety Spectacles	400.-
7.4 Safety Goggle	175.-
7.5 Welder Goggle	400.-

8. FACE PROTECTION

8.1 Face Shield	750.-
8.2 Face-Shield/Helmet	875.-
8.3 Hand Shield	440.-
8.4 Welding Helmet	700.-
8.5 Leather Welding Hood	3,000.-

LIST OF DISTRIBUTOR IN ENVIRONMENTAL AND SAFETY PROTECTION EQUIPMENT

ALARM SYSTEM

BURGLAR ALARM SYSTEM

A.K.Eng Lp......... 511-3425
24/101 Soi 21 Lariprao, Bkk.
BBC BROWN BOVERI (T)LTD.
.... 391-5177
189 Asoke Rd, Sukhumvit 21,Bkk.
B.GRIMM & CO., R.O.P.
..................252-4081,252-9131
1643/4 Petchburi Rd.,Bkk. 10400
Fire Appliances Sales &
Service Center L.P........233-0704
900 Rama IV Rd., Bkk
O.K.Electronices L.P......214-4309
2115/15 New Patchburi Rd., Bkk.
Porn Sawan Trading Co., Ltd. 278-1694
1165 Paholyothin Rd., Bkk.
S.K.Alarm Systems..........214-4541
120 Chula Soi 36 rama IV, Bkk.
Security Systems Ltd.......233-4316
216 Convent Rd., Bkk.
Siam Syndicate Co., Ltd....278-1778
81 Soi 14 Phaholyothin Rd., Bkk.
Siam Industrial Marketing Co.,Ltd.
...........................278-1778
81 Soi 14, Phaholyothin Rd, Bkk.
Siam Syndicate Co., Ltd....279-4630
260 Phaholyothin Rd.,Bkk.

Tarmallpark Typewritter L.P. 234-6964
   12/3 Silom Rd., Bkk.
Thailand Technical Services Co., Ltd.
...........................392-8307
   110100/42 Sukhumvit Rd., Bkk.

FIRE ALARM SYSTEM

BBC BROWN BOVER (T) LTD.
.........................391-5117
   189 Asoke Rd., Sukhumvit 21, Bkk.

B. Grimm & Co., R.O.P.
   ....252-4081, 252-9131
   1643/4 Petchburi Rd. Bkk. 10400

BERLI JUCKER...............252-4071-9
   542/1 Ploenchit Rd., Bkk.

Fire Appliances Sales &
Service Center L.P.....................233-0740
   900 Rama IV Rd., Bkk.
Fire King Trading L.P... 233-8448
   368 Siphya Rd., Bkk.
Hart Engineering (T) L.P...............314-3959
   30 Soi Ramkhambaeng 12, Bkk.
Huat Seng Co., Ltd.....................221-1587
   8 Yawaralj Rd., Bkk.

Integrated Eng. Co., Ltd...............391-0740
8 Soi Sawasdi,
Sukumvit Rd., Bkk.
Nippon Chemical (T) Co.,Ltd.
....................252-2915
1831/5-6 New Phetburi Rd., Bkk.
Pae (T) Co., Ltd...................245-1698
New Asoke, Lardprao Rd., Bkk.
Siam Delta C., Ltd.................514-4205
3082/9 New Petchburi Fd.,
Near Ekamai Bridage, Bkk.
Siam Industrial Marketing Co., Ltd.
.................................278-1778
81 Soi 14 Phaholyothin Rd., Bkk.
Siam Syndicate Co., Ltd............279-4630
260 Pholyothin Rd., Bkk.

SQUARE D.CO.(THAILAND) LTD..
..................................235-9828
8 Fl. U-Chuliang Foundation Bldg.
968 Ramad Iv V Rd., Bkk.
Tanin Engineering L.P..............586-8445
43/2 Phacharaj Rd., Dusit, Bkk.
Tarmallpark Typewriter L.P. 234-6964
12/3 Soiom Rd., Bkk.
Thailand Technical Services Co., Ltd.
..................................392-8307
The Thai Fire Fighting Equipment Co., Ltd.
..................................234-8265
3 Soi Pradit Surawongse, Bkk.

Vidhyakom Co., Ltd.................281-5211
158 Phyathai Rd., Bkk.

SAFETY EQUIPMENT & SYSTEM

WHOLESALER & SUPPLIER

B.GRIMM & CO., R.O.P.... 252-4081
1643/4 Nw Patchuri Rd., Bkk.
Daily Enterprise Parts Center
L.P......................281-1703
204/3 Visuthikasat, Bkk.
Device Trading L.P........282-0321
222/11-13 Larn Luang Rd., Bkk.
Dusadee Eng & Construction
L.P.......................391-8847
16/1 Soi 22 Sukhumvit Rd., Bkk.
EAST ASIA INTERNATIONAL CO.,LTD.
..............................233-5656
142 N. Sathorn Rd., Bkk.
Fiche-Bauche Thailand Co.,Ltd.
..............................235-0515
29/3 Soi 1 Saladaeng, Bkk.
Fire Protection Equipment & Chemicals Co.
..............................221-9744
5-7 Bumrungmuang Rd., Bkk.
Indo Thai Trading Ltd...........221-9767
23-25 Burapha Rd., Bkk.
Nippon Chemicals (T) Co.,
Ltd.............................2522915
1831/5-6 New Petchburi Rd. Bkk.

P. Narong Ind. Co., Ltd........284-0209
929/2 Sathupradit Rd., Bkk.
Phol Dhanya Co., Ltd...............223-6013
334-6 Songwad 1 Rd. Bkk.

PIONEER ENGINEERING CO., LTD.
...............................282-2471-2
417/9-11 Victory Monument Circle,
Rajvithi Rd., Bkk. 10400

RONIM MARKETING SERVICES (Thailand) LTD.
.... 391-0488
38 Soi Ekamai, Bkk.
Safety First Corp. Ltd..........252-5358
33/2 Sukhumvit Rd. Bkk.
Security Systems Ltd............233-4316
2/6 Convent Rd.,Bkk.
Siam Vidhya Co., Ltd............233-1365
946 Dusit Thani Bldg.,
Silom Rd., Bkk.
Tarmullpaek Tyupewriter
L.P............................234-6964
12/3 Silom Rd. Bkk.

UTILITY ELECTRIC CO., LTD.....251-9718
55/24-25 Phyathai Rd., Bkk.
Yong Kee Liab Heng Co.,Ltd.
...............................234-2244

FIRE FIGHTING & PROTECTION

Anti-fire L.P.................392-4242
111 Soi Rimthang Rotfai,
Rama IV Rd., Bkk.
Asian Trading L.P.............282-3581
B.GRIMM & CO., R.O.P..........252-4081
1643/4 Petchburi Rd. Bkk.
Bangkok Fire Protection Supplies L.P.
.............................331-2429
1911/1911-2 Sukhumvit, Bkk.
Chaw Phaisalsin L.P...........235-5072
326/19 Rama IV Rd., Bkk
Device Trading l.P............281-0683
222/11-3 Larn Luang Rd., Bkk.
Dhanasup Charoen Trading L.P..
..............................251-0335
355 Chula Soi 9, Bkk.
Fire Appliances Sales &
Service Center L.P............233-0740
900 Rama IV Rd., Bkk.
Fire Kerity Chemical (T)......286-7553
456/2 Sathorn Tai Rd., Bkk.
Fire King Trading L.P.........233-8448
368 Siphya Rd., Bkk.
Fire Protection Equipment &
Chemicals Co., Ltd............221-9744
5-7 Bamrungmuang Rd., Bkk.
Fire Stopper L.P..............222-6980
62 Rajdamnoen Rd., Bkk.

Gerson & Sons Ltd.............234-2914
287 Silom Rd., Bkk.
Huat Seng Co., Ltd............221-1587
8 Yawaraj Rd, Bkk.
Integrated Engineering Co.,Ltd.
.............................391-0701
8 Soi Sawasdee, Kukhumvit Rd., Bkk.
Nippon Chemical (T) Co., Ltd..252-2915
1831/5-6 New Petchburi Rd., Bkk.
Pae (T) Cp., Ltd..............286-2471
1032/1-5 Rama IV Rd. Bkk.
S.Somboon Phanich L.P.........234-2175
372-4 Siphya Rd., Bkk.
Safety First Corp. Ltd........252-5358
33/2 Sukhumvit, Bkk.
Security Systems Ltd..........233-4316
2/6 Convent Rd., Bkk.
Tanin Eng. L.P................585-84465
43/2 Pracharaj 1, Bkk.
Thai Fire Fighting Equipment
Co., Ltd......................234-8265
3 Soi Pradit, Surawongse Rd., Bkk.
Union Development Co., Ltd. 251-9138
95 Rayadamri Arcade, Bkk.
United Machinery Co.,Ltd.
.............................282-7140
20 Larn Luang Rd., Bkk.

HEADGEAR & FACE SHIELDS

Device Trading L.P...........282-0321
   222/11-13 Larn Luang Rd., Bkk.
Dhanasup Charoen Trading L.P.
..............................251-0335
   355 Rama IV Rd., Bkk.
Nippon Chamical (T) Co.,Ltd.
..............................252-2915
   1831/5-65 New Petchburi Rd., Bkk.
Phol Dhanya Co., Ltd...........233-6013
   334-6 Songwad Rd., Bkk.
Safety First Corp Ltd..........252-5358
   33/2 Sukhumvit Rd., Bkk.
Technogroup Co., Ltd...........279-1788
   81 Phaholythin Rd., Bkk.

SAFETY CLOTHING

B. GRIMM & CO., R.O.P.
...............................252-4081, 252-9131
   1643/4 Petchburi Rd., Bkk 10400
Device Trading L.P.............282-0321
   22/11-13 Larn Luang Rd., Bkk.
Dhanasup Charoen Trading L.P.
...............................251-0335
   335 Rama IV Rd., Bkk.

RONIM MARKETING
SERVICES (Thailand) LTD. 391-0488
   38 Soi Ekamai, Bkk.

SAFETY HELMET

Safety First Corp, Ltd........252-5358
33/2 Sukhumvit 19, Bkk.
Technogroup Co., Ltd..........279-1788
81 Phaholyothin Rd., Bkk.
United Machinery Co.,Ltd.
...............................282-7140
20 Larn Luang Rd., Bkk.

WATER & WASTE WATER TREATMENT

WHOLESALERS & MANUFACTURERS

Aquachem Co., Ltd..............277-1124
92 Vibhavadi-Rangsit Rd., Bkk.
BBC BROWN BOVERI (T) LTD.
...............................319-5177
189 Asoke Rd., Sukhumvit 21, Bkk.
B.GRIMM & CO R.O.P.............252-4081
1643/4 Petchburi Rd., Bkk 10400
Boonyium & Associates Ltd. 391-1044
126 Soi 63 Sukhumvit, Bkk.
C.M.P. Suipplies L.P...........314-6714
70 Soi Maenkhiesn 2,
Ramkambaeng Rd., Bkk.
Chemical Services R.O.P........391-6866
392/12-5 Sukhumvit Rd., Bkk.
Connelll Brothers Co. (T) Ltd.
...............................252-4158
87 Sukhumvit Rd., Bkk.

Creation Center Co., Ltd.......252-2310
199/1-2 Siyaek, Pathumwan, Bkk.
Creation Co., Ltd.............233-1110
28/12 Soi Suan, Silom, Bkk.
Dynamic Supply Eng R.O.P.....392-853
12 Soi Passana 1, Ekamai, Bkk
EAST ASIATIC CO., (T) LTD.
(THE)........................233-2020
53-55 Oriental Ave, Bkk.
EKPAC (EKMAN) ENGINEERING
CO,.LTD......................392-9081-4
561/1 Corner Soi31, Sukhumvit Rd., Bkk.
Far Eastern Corp. Ltd..........281-1057
300/9 Phyathai Rd., Bkk.
Goshu Kohsan Co., Ltd..........234-7753
403/19 Soi Surasna, Silom, Bkk.
Int'l Chemicals (ICECO) &
Eng. Co., Ltd..................392-1470
603-5 Soi 71 Sukhumvit, Bkk.
ITALTHAI INDUSTRIAL
CO.,LTD.......................314-6101
2013 New Petchburi Rd., Bkk.
K. Stone Corp. Ltd.............281-0310
3/F, Acmy Bldg.,
156/20-1 Petchburi Rd., Bkk.
Kitti Agencies L.P.............392-4757
30/6 Soi 23 Sukhumvit Rd., Bkk.
Kriang Krai Trading L.P...... 233-8791
1018/2 Rqama IV Rd., Bkk.

LINDETEVES (Thailand)
LTD............................233-2301
457/2 Silom Rd., Bkk.
Liquid Carbonic (T) Co.,
LTd............................233-2476
197/1 Silom Rd., Bkk.
March Marine Co., Ltd.........424-4666
630/26 Phrapinklao, Bkk.
Mechsan Supply & Service
Co., Ltd......................277-4228
605 Soi Phibulupatham, Bkk.
Nisshin Eng. (T) Co., Ltd.....252-1692
Oregon Co., Ltd...............391-2216
1763-5 Sukhumvit Rd.,Bkk.

POLYTECHNOLOGY CO., LTD.......245-2248
7/28-9 Soi Kwanpatana 2,
Asoke-Dindaeng, Bkk.
S. Napa Trading R.O.P.........391-6886
392/12-5 Sukhumvit Rd., Bkk.
Sacco Co., Ltd................245-0914
7/28 Asoke Dindaeng Rd., Bkk.
Saritary Eng. Supply L.P......511-1058
Sepatch L.P...................251-4313
112 Wireless Rd., Bkk.
Siam Mass L.P.................278-2692
135 Soi Luecha,
Paholyothin Rd., Bkk.
Siam Pacific Pollution Works
L.P 251-7934
149 Bangkok Bazaar, Bkk.

SIAM TECHNOLOGY (SIAMTEC)
CO., LTD......................252-2222
6/F., Nai Lert Bldg., 87 Sukhumvit
Rd., Bkk.
Siam Trade L.P................234-4690
191Surawongse Rd., Bkk.
Siew & Co., Ltd................222-8191
484-90 Mahachai Rd., Bkk.
Standard Trading & Water
Treatment L.P..................391-3976
173/5 Soi 16 Sukhumvit Rd., Bkk.
Stanlab L.P...................391-1436
54 Soi 1 Sukhumvit Rd., Bkk.
Tong Thaveesin Engineering Co.,Ltd.
..............................235-7724
281/17-18 Silom Rd., Bkk.
Uniroyal Machinery & Equipment Co.,Ltd.
..............................377-0288
51/215-6 Drive-In-Square,Bkk.
Water Engichem Service L.P. 392-6458
603-5 Soi 71, Sukhumvit, Bkk.

ANALYZER FOR WASTE WATER CHARACTERISTIC

BERLI JUCKER................252-4071-9
542/1 Ploenchit Rd., Bkk.
Int'l Chemicals (ICECO)
& Eng. Co., Ltd.............391-2788
603-5 Soi 71 Sukhumvit, Bkk.

Mechsan Supply & Service Co.,Ltd.
............................277-4228
605 Soi Pibul Uppatham,
Lardprao Rd.,Bkk.

SIAM TECHNOLOGY (SIAMTEC) CO.,LTD.
..............................252-2222
6/F., Nai Lert Bldg., 87 Sukhumvit
Rd., Bkk.

Thuna Thaveesin L.P..........235-7724
281/18-18 Silom Rd.,Bkk.

Thai Unique Co.,Ltd..........222-2437
159-161 Tanao Rd., Bkk.

World Mechanics & Works Co.,Ltd.
...............................222-1759
288-290 New Rd., Bkk.

ANTHRACITE

Creation Center Co.,Ltd.......252-2310
199/1-2 Patumwan, Bkk.

Sacco Co,Ltd..................245-0914
7/38 Soi Kwan-Patana 2,
Asoke-Dindaeng Rd.,Bkk.

Standard Trading & Water
Treatment L.P..................391-3976
173/5 Soi 16 Sukhumvit, Bkk.

DEMINERATIZATION EQUIPMENT

Creation Co.,Ltd...............233-1110
28/12 Soi Susarn, Silom, Bkk.
Int'l Chemicals (ICECO)
& Eng. Co.,Ltd.................391-2788
603-5 soi 71 Sukhumvit, Bkk.

ITALTHAI INDUSTRIAL CO.,LTD....314-6101
2013 New Petchburi Rd.,Bkk.
PIONEER ENGINEERING CO., LTD....282-2471
417/9-11 Victory Monument Circle,
Rajwithi Rd.,Bkk.
POLYTECHNOLOGY CO.,LTD..........245-0914
7/38 Soi Kwan-Patana 2,
Asoke-Dindaeng Rd.,Bkk.
SIAM TECHNOLOGY (SIAMTEC) CO.,LTD..252-2222
6/F., Nai Lert Bldg,87 Sukhumvit
Rd., Bkk.
Thuna Thaveesin L.P................235-7724
281/17-18 Silom Rd., Bkk
WORLD MECHANICS & WORKS CO,LTD.....222-1759
288-290 New Rd.,
Sampanthawongse, Bkk.

FLOCCULANTS

Creation Center Co.,Ltd.......252-2310
199/1-2 Patumwan, Bkk.
Int'l Chemical (ICECO)
& Eng. Co., Ltd...............391-2788
603-5 Soi 71 Sukhumvit, Bkk.
Sacco Co.Ltd..................245-0914
7/38 Soi Kwan-Patanà 2,
Asoke Dindaeng Rd., Bkk.

WORLD MECHANICS & WORKS CO.,LTD...221-1759
288-290 New Rd. Sampanthawongse, Bkk.

ION EXCHANGE RESINS

Asian Polytrade Co.,Ltd........... 393-5921
4533-5 Sukhuumvit Rd.,Bkk.
BAYER THAI CO.,LTD. 233-1440-50
130/1 North Sarthorn Rd.,Bkk.
Boonyium & Associates Co.,Ltd.......391-1044
126 Ekamai Rd.,Bkk.
Creation Co.,Ltd....................233-1110
28/12 Soi Susan, Silom, Bkk.
Creation Center Co.,Ltd.............252-2310
199/1-2 Patumwan, Bkk.
DIETHELM PHARMACHEM LTD.............221-1141
594 Luang Rd.,Bkk.
Dow Chemical Thailand Ltd............393-0131
3223 Sukhumvit Rd.,Bkk.

Dynamic Supply Eng. R.O.P. 392-5313
12 Soi Pasana 1,
Ekamai Rd.,Bkk.

EAST ASIATIC CO., (T) LTD. (THE)......233-2020
53-55 Oriental Ave., Bkk.

Goshu Kohsan Co.,Ltd..................234-7753
403/9 Surasena, Silom Rd., Bkk.

Int'l Chemical & Eng. Co. Ltd. 391-0722
614 Sukhumvit Rd., Bkk.

ITALTHAI INDUSTRIAL CO.,LTD......314-6101
2013 New Patchburi Rd., Bkk.

R. Schaller Ltd...................392-9119
54 Soi Asoke,
sukhumvit 21, Bkk.

Sacco Co.,Ltd......................245-0914
7/38 Soi Kwan-Patana 2,
Asoke-Dindaeng Rd.,Bkk.

Siamtrade Int'l Co.,Ltd.............392-3632
593/19 Sukhumvit Rd.,Bkk.

SOUTH CITY SUPPLIES L.P.............391-1095-6
20/2 Soi Chaemchan, Sukhumvit 63, Ekamai, Bkk.

Standard Trading & Water
Treatment L.P......................391-3976
173/5 Soi 16 Sukhumvit, Bkk.

Thai Chemical & Eng. Co.,Ltd. 252-4797
3rd., Fl.,UFC Bldg.,
Siam Square Soi 7, Bkk.

IRON & MANGANESE ERADICATORS

Creation Co.,Ltd.....................234-2875
28/12 Soi Susarn, Silom, Bkk.
Sacco Co.,Ltd................245-0914
7/38 Soi Kwan-Patana 2,
Asoke-Dindaeng Rd.,Bkk.
Standard Trading & Water
Treatment L.P................391-3976
173/5 Soi 16 Sukhumvit Rd., Bkk.
Thuna Thaveesin L.P..........235-7724
281/17-18 Silom Rd.,Bkk.

SAND FILTERS

Aquachem Co., Ltd.............277-1124
92 C-Bldg, Vibhavadi Rangsit Rd.,Bkk.
Creation Co.,Ltd...............233-1110
28/2 Soi Susarn, Silom, Bkk.
POLYTECHNOLOGY CO., LTD........245-2248
7/28-9 Soi Kwan Patana 2,
Asoke-Dindaeng. Bkk.
SIAM TECHNOLOGY (SIAMTEC) CO.,LTD...252-222
6/F., Nai Lert Bldg., 87 Sukhumvit Rd.,Bkk.
Standard Trading & Water
Treatment L.P.....................391-3976
173/5 Soi 16 Sukhumvit Rd.,Bkk.
WORLD MECHANICS & WORKS CO.,LTD.   222-1759
288-290 New Rd.,
Sampanthawongse, Bkk.

SURFACE AERATOR

Allied Eng.Co.,Ltd....................392-5259
3 Ekamai Rd.,Bkk.
Dynamic Supply Eng. R.O.P. 392-8532
12 Soi Pasana 1 Ekamai, Bkk.
EKPAC (EKMAN) ENGINEERING CO.,LTD......392-9081-4
561/1 Corner Soi 31,Sukhumvit Rd., Bkk.
Int'l Chemicals & Eng. Co.,Ltd.........391-2788
603-505 Sukhumvit 71 Bkk.
ITALTHAI INDUSTRIAL. CO.,LTD........314-6101
2013 New Petchburi Rd.,Bkk.
Mechsan Supply & Service Co.,Ltd...277-4228
605 Soi Phibulupatham,
Lardprao Rd.,Bkk.
POLYTECHNOLOGY CO.,LTD...............245-2248
7/28-9 Soi Kwanpatana 2,
Asoke-Dindaeng Bkk.
R. Schaller Ltd......................392-9119
54 Soi Asoke, Sukhumvit, Bkk.
Sacco Co.,Ltd........................245-0914
7/38 Soi Kwan-Patana 2,
Asoke-Dindaeng, Bkk.
Thuna Thaveesin L.P...................235-7724
281-17-18 Silom Rd.,Bkk.
WORLD MECHANICS & WORKS CO.,LTD........222-1759
288-290 New Rd., Sampanthawongse, Bkk.

WASTE RECOVERY PLANT MACHINERY

EKPAC(EKMAN) ENGINEERING CO.,LTD....392-9081-4
561/1 Corner Soi 31, Sukhumvit Rd., Bkk.
ITALTHAI INDUSTRIAL CO.,LTD.........314-6101
2013 New Petchburi Rd.,Bkk.
RIECKERMAN (Thailand) co.,Ltd......234-3061
46/1 N.Sathorn Rd., Bkk.
SIAM TECHNOLOGY (SIAMTEC) CO.,LTD...252-2222
6/F Nai Lert Bldg, 87 Sukhumvit Rd., Bkk.

WATER CONDITIONING MACHINERY

Aquachem Co., Ltd.................277-1124
92 Vibhavadi Rangsit Rd.,Bkk.
C.M.P. supplies L.P................392-2464
80/1 Sukhumvit Rd.,Bkk.
International Chemicals & Eng. Co.,Ltd.392-4170
603-5 Sukhumvit 71, Bkk.
Kriang Krai Trading L.P..............233-8791
1018/2 Rama IV Rd., Bkk.
Mechsan Supply and Service Co.,Ltd...277-4228
605 Ladprao Rd.,Bkk.
Pranee Phan Ltd.......................279-0182
248 Phaholyothin Rd.,Bkk.
R.SCHALLER cO.,lTD.....................391-4015
54 Sukhumvit Rd.,Bkk.
Sacco Co,Ltd..........................245-0914
7/38 Asoke-Dindaeng Rd.,Bk.
Saritary Eng. Supply L.P..............511-1048
874 Ladprao Rd.,Bkk

SIAM TECHNOLOGY (SIAMTEC) CO.,LTD.....252-2222
6/F., Nai Lert Bldg. 87 Sukhumvit
Rd., Bkk.

Siew & co,Ltd.........................222-8191
484-90 Mahachai Rd.,Bkk.

Stanlab L.P...........................391-1436
54 Asoke Sukhumvit, Bkk.

Thuna Thaveesin L.P...................235-7714
281-17-8 Silom Rd.,Bkk.

Watana Mach.Co.,Ltd...................233-9775
9/11-2 Thaniya Rd.,Bkk.

WATER SOFTENER

Allied Eng.,Co.,Ltd...................392-5266
3 Ekamai Rd.,Bkk.

Creation Co.,Ltd......................392-5266
28/2 Soi Susarn, Bkk.

Goshu Kohsan Co.,Ltd..................2347753
403/19 Soi Surasena, Silom,Bkk.

Int'l Chemicals (ICECO)& Eng.Co.,Ltd..391-2789
603-5 Soi 71 Sukhumvit, Bkk.

ITALTHAI INDUSTRIAL CO.,LTD...........314-6101
2013 New Petchburi Rd.,Bkk.

Mechsan & Supply & Service Co.,Ltd....277-4226
605 Soi Phibulupatham, Bkk.

POLYTECHNOLOGY CO.,LTD................245-2248
7/28-9 Soi Kwan-Patana 2,
Asoke-Dindaeng Rd.,Bkk.

SIAM TECHNOLOGY (SIAMTEC)CO.,LTD......252-2222
6/F.,Nai Lert Bldg., 87 Sukhumvit Rd.,Bkk.

Thai Chemical & Eng.Co.,Ltd...........252-4797
3rd Fl.,UFC Bldg, Siam Sq.,Bkk.
Thuna Thaveesin L.P...................235-1724
281/17-18 Silom Rd.,Bkk.
WORLD MECHANICS & WORKS CO.,LTD.......222-1759
288-290 New Rd., Sampanthawongse,Bkk.

PROTECTIVE EYEWARE

Device Trading L.P....................282-0321
222/11-13 Larn Luang Rd.,Bkk.
Dhansasup Charoen Trading L.P.........251-0335
355 Rama IV Rd.,Bkk.
Nippon Chemical (T) Co.,Ltd...........252-2915
1831/5-6 New Petchburi Rd., Bkk.
RONIM MARKETING SERVICES (THAILAND)LTD.391-0488
38 Soi Ekamai, Bkk.
Safety First Corp.Ltd.................279-1788
81 Phaholyothin Rd.,Soi 14, Bkk.
Thai Fire Fighting Equip. Co.Ltd......233-5465
197/3 Surawongse Rd.,Bkk.
United Machinery Co.,Ltd..............282-7140
20 Larn Luang Rd.,Bkk.

RUBBER GLOVES

Bangkok Glove Fc.ry L.P...............227-2033
4-91 Samennai Rd.,Bkk.
Choeng Liang Thye L.P.................252-2237
100/15 Gp.2, Soi On-nuch,
Suan Luang, Prakhanong, Bkk.

Device Trading L.P....................282-0321
222/11-13 Larnluang Rd.,Bkk.
Dhanasup Charoen Trading L.P..........251-0335
355 Rama 4 Rd.,Bkk.
J.Sui Koong Supplies L.P..............223-4860
13 Chalerm Khetr3, Bkk.
Nippon Chemical (T) Co.,Ltd...........252-2915
1831/5-6 New Petchburi,Bkk.
Pan Global Enterprise Co.,Ltd.........251-5547
183 Jirestone Bldg.,Bkk.
Phol Dhanya Co.,Ltd...................223-6013
334-6 Songwad Rd.,Bkk.
Safety First Corp Ltd.................252-5358
33/2 Sukhumit Rd.,Bkk.
Technogroup Co.,Ltd...................279-1788
81 Phaholythin Rd.,Bkk.